CHEMICAL & METALLURGICAL ENGINEERING

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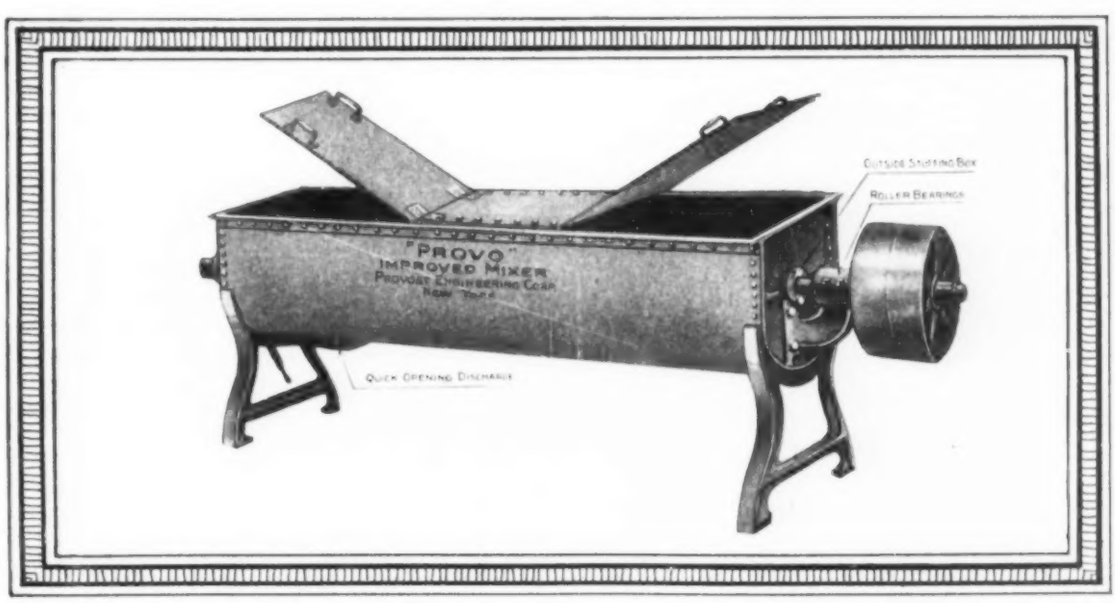

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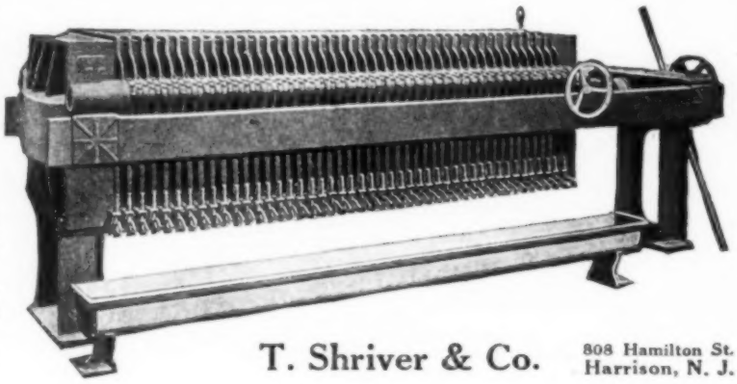

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CHEMICAL & METALLURGICAL ENGINEERING

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Shall the Government Patent and Develop The Inventions of Its Employees?

UNIQUE in the cordial relations existing between Government officials and industrial scientists and engineers was the meeting held at the Chemists' Club in New York on the evening of Oct. 15 to discuss certain plans for patenting and developing the inventions of Government employees. Under the auspices of the American Institute of Chemical Engineers, the New York sections of the American Chemical and American Electrochemical societies, and the American Section of the Society of Chemical Industry, Dr. FREDERICK G. COTTRELL, Director of the Bureau of Mines, and Dr. CARL L. ALSBERG, Chief of the Bureau of Chemistry, explained their problems in disposing of inventions of Government employees, made in the course of official duties, and advocated legislation for dealing with these "byproducts" of regular work. A full report of the meeting, prepared from stenographic notes, is published elsewhere in this issue.

We regard the subject as of the utmost importance to industry, because it involves the question of the encroachment of Government on private business. It involves also a new departure in developing patentable inventions made by Government employees, and thus vitally affects the future relations of Government and industry. For these and other evident reasons we commend to the chemically-controlled industries a careful study of the plan outlined by Dr. COTTRELL, as all of them may be concerned in the course of time.

Briefly stated, the thesis of Dr. COTTRELL is this: In the course of their official work in fundamental research, industrial investigations or for the purpose of law enforcement, Government employees inevitably make discoveries and inventions which have actual or potential commercial value, provided they are developed and brought to the point of industrial application. Lacking any suitable machinery for this purpose, these inventions are lost to industry and a valuable byproduct of Government research is neglected. Dedication of the patent to the public is claimed to be futile as far as further development of the idea is concerned, because private industry will not take up and develop an invention on which it has not the protection afforded by a patent or by a license from the patentee.

The remedy proposed is to authorize the Federal Trade Commission to accept assignment of such patents, license their use and collect royalties which are to be paid to the Treasurer of the United States, excepting a part which is to be paid to the inventors whose patents are thus handled. Legislation to this effect has already passed both houses of Congress, in slightly different form in each, and is now in conference committee pending action at the forthcoming session.

It may be surmised that industrial scientists are not pleased with the prospect of thus injecting a new and unknown element into the already highly competitive state of private business—and for a variety of reasons which we believe will increase as knowledge of the plan becomes more widespread. For ourselves we see in the proposal an experiment in economics and patent administration which is not justified in the light of present industrial conditions, and one which is almost certain to lead to friction between Government and business and in many cases an abrupt termination of the cordial relations now existing between certain industries and Government bureaus. While the plan admittedly has not had wide circulation in business and industrial circles, we have failed to find an advocate outside of Government or quasi-public institutions. Is it not a significant fact that the industries which are to be affected in a practical way by this legislation will have none of it, being quite willing to take chances with competitors in developing business but viewing with apprehension the entrance of a third party into the field on a basis which, in the nature of the case, can scarcely be impartial? The whole subject is one that needs more counsel between Government and business before it is finally settled by legislation.

Examination of the bill suggests to us the following objections to its passage: In the first place, rightly or wrongly, business has no confidence in the Federal Trade Commission; and any proposal which places in the hands of that body the power which the present bill confers will be regarded with suspicion. Power once acquired by a governmental agency is not lightly abandoned. More than that, it is likely to be extended as time passes, until the original purport and intention of even an acceptable measure are lost and forgotten. In the present case the success of the plan depends on its administration, and there is no certainty that that would be in accordance with the good intentions of its promoters. Although the latter argue that the bill is an enabling act and not mandatory, and that therefore it will fail if not wisely administered, it would still appear that under its terms the President has the power to direct that all patentable matter resulting from research work in any Government department be patented and administered by the Federal Trade Commission. Thus the United States could become a vast holding company, owning patents affecting practically every branch of private industry.

But granting that the act is wisely administered, we still have the necessity of partiality in its administration, for unless licenses are restricted in number there is no gain over dedication of the patent to the public in the first instance. Thus we will be confronted with the delicate decision as to how many licenses shall

be issued, and still more important, to whom. If such a situation can be handled by the Federal Trade Commission with satisfaction to all concerned an unexpected measure of success will have been achieved. No one believes it is possible. By the terms of this bill the Government is committed in advance to the principle of participation in private business on a selectively competitive basis. Its patented discoveries and inventions will not flow to industry as a whole, but to such units thereof as may be selected. Its non-patented, and presumably inconsequential, discoveries will be open to all as heretofore. It is quite conceivable that the Federal Trade Commission, in order to protect its favored licensees, will have to conduct a lively legal business in suits for infringement against concerns which see fit to ignore the discriminative policy.

In the meantime what about the effect of the bill on the employee in whose interest, in part, the measure has been drawn? Dr. COTTRELL rightly minimizes the reward to the employee as a feature of the bill, and lays principal stress on the benefit to the public by bringing inventions into practical use. But the employee is to profit nevertheless, and we may well inquire into his attitude if the bill becomes law. Will it be humanly possible for him to forget that then there will be some incentive for him to produce patentable inventions? Will there not be the temptation, which may even become an established tendency, to pursue those lines of industrial investigation that will lead to immediate reward, and neglect more fundamental research that could benefit the whole industry without profit to the individual? Putting these questions to a man recently resigned from Government service, he admitted that the existence of such a law would be bound to affect his attitude somewhat. How shall we commercialize the inventions without at the same time and in some degree commercializing the inventors? And how will the scheme be regarded by that employee of the Government whose work is outside the field of patentable invention? Ability and meritorious service are not confined to the scientific bureaus alone; and yet the bill would discriminate between those employees who, as a class, may make and receive reward for patentable inventions and those who, from the very nature of their work, may not. Certainly no private industry would deliberately inject so disquieting and disturbing a factor into its organization, and there is no reason to believe that its effects will be less baneful inside the Government than without.

The measure is admittedly an experiment in economics in order to solve a problem arising in certain Government bureaus. We doubt if the experiment is called for either on account of an accumulation of valuable inventions in those bureaus or for the benefit of the public. Government inventions probably are no better or worse than the average run emanating from industries having research laboratories, and we know that most of them are inconsequential as far as practical development is concerned. If anyone thinks that valuable and practical patents are numerous let him study the patents expiring, say in 1920, which are pertinent to his industry, and see how many he will be inclined to adopt. Those on which he would spend much money will be a surprisingly small, if not fractional, percentage of the whole.

As for the argument that patents dedicated to the public will not be accepted by industry on account of lack of protection during the development period, there may be another way to make such inventions effective—viz., by promulgating such industrial regulations as will call for the patented article or process. This could be done consistently in the interest of the public, and more impartially than the Federal Trade Commission could grant licenses.

In addition to the foregoing there are many other objections to the legislation, which will be found in our report of the meeting. The subject is a large one and no attempt has been made to exhaust it. We believe that one of the parties at interest—industry—has not been fully advised of the purport of the legislation and consequently has not fully conceived its effects. The printed hearings on the bill reveal no witnesses from industry or from any other source appearing against the measure. Immediate steps should be taken by industrial organizations to inform themselves fully in the matter and to urge rehearings if such are possible. No emergency exists which could be met by immediate passage of the bill, and surely it would be better to have all elements harmonious if such a thing were possible. If industry does not take advantage of this opportunity to make itself heard and felt, then it will have no fault to find with those who, from altruistic and sincere motives and as a result of long study and deep thought, propose experiments in patent administration in the interest of the public. The matter has now received more publicity than all that has gone before and those who will be adversely affected will proceed with their eyes open. They should not only marshal facts in opposition to the plan, but should if possible suggest alternative methods of solving the problem encountered by Government officials. Immediate action is necessary if anything is to be accomplished.

Thoughtless Legislation

IT WILL BE recalled that one of the aims of the national prohibition act as set forth in its title was "to insure an ample supply of alcohol and promote its use in scientific research and in the development of fuel, dye and other lawful industries." In spite of this, the regulations issued by the Bureau of Internal Revenue have tended somewhat to hamper the legitimate use of non-beverage alcohol. When, therefore, additional burdens are imposed upon the user and distributor of non-beverage alcohol through state legislation, the industry cannot be expected to thrive.

Such is the condition in New York State at the present time. The liquor tax law (Chap. 911, Laws of New York) imposes a tax of thirty cents upon each gallon of non-beverage alcohol manufactured or sold within the State of New York. Alcohol manufactured outside of the state is not subject to tax unless resold within the state. The result is that the legitimate consumer of non-beverage alcohol is forced to pay a premium of thirty cents a gallon unless he is in a position to buy directly from a producer outside of New York State.

Were this a new measure, we could indicate only the possible consequences. As it is, the law has been in effect since May 24, 1920, and we have only to point to the actual results. Those manufacturers who have been producing alcohol within the state have closed their plants and some of them have moved to other states. Large dealers and distributors of alcohol have refused

to do business within the state and their premises have been closed to such an extent that it is almost impossible to buy alcohol in the State of New York. Some of the larger dealers have been incorporated in other states and even though the law be repealed their business will be lost to the State of New York for many years.

Surely a little intelligent forethought would have prevented the drafting of a measure which discriminates against legitimate business interests of the state wherein the legislative body convenes. As the situation stands, it is clearly the duty of the New York Legislature to repeal or amend the offending sections of the liquor tax law.

Education by Myth And Verbal Subtleties

ONE of the most distinguished of British scientists, FREDERICK SODDY, attacked the old-time classical education in a recent number of *Nature*. He charged that the classical or arts college educates by "myth and verbal subtleties," arguing, as HUXLEY did before him, that science is slighted for "mediæval and drawing-room studies." Continuing, he said that "the traditional education given to the ruling classes trains them to be impervious to new knowledge and able only to find in the old and dead past ideals for imitation and reverence." Science has produced most of our material wealth and has "demolished the cobwebs of traditional economics and finance," giving laws based on fundamentals and truth. According to Professor SODDY, who has had excellent opportunity to observe classical education at Oxford, where he has studied and lectured, much of the world's trouble today from war and industrial discontent is the consequence of the wrong education of the ruling class.

This is a striking indictment of classical education, all the more so because of Professor SODDY'S concise way of stating it: "myths and verbal subtleties." He is objecting to the emphasis that arts colleges place upon the vast literature of old customs and traditions, upon seemingly aimless folk-lore, and upon elaborate myths such as those told by HOMER and VIRGIL. Such studies make attractive the circuitous and wasteful methods by which man has drifted from one thing to another, the inexplicable obsessions under which he has labored, the blind ignorance that has made progress so difficult and the obstinacies and loyalties that blend so curiously in human nature. Professor SODDY in speaking of verbal subtleties is objecting to the hair-splitting and the mechanical trifling that have characterized universities since their founding, and that still persist—strange mediæval relics in our modern times.

In H. G. WELLS' "Outline of History" he points out the development of the pedant among the philosophers of the Alexandrian period, after that Egyptian city ceased to draw men like EUCLID, ARCHIMEDES and HERON. Says Mr. WELLS, speaking of Alexandria's famous museum (or university) as it existed about the time of CHRIST: "Wisdom passed away from Alexandria and left pedantry behind. For the use of books was substituted the worship of books. Very speedily the learned became a specialized queer class with unpleasant characteristics of its own. The museum had not existed for half a dozen generations before Alexandria was familiar with a new type of human being; shy, eccentric, unpractical, incapable of essentials, strangely fierce upon trivialities of literary detail, as bitterly jealous of the colleague within as of the unlearned without, the bent scholarly man. He was as intolerant as a priest, though he had no altar; as obscurantist as a magician, though he had no cave. For him no method of copying was sufficiently tedious and no rare book sufficiently inaccessible. He was a sort of byproduct of the intellectual process of mankind . . . We have still to discover how to preserve our centers of philosophy and research from the caking and darkening accumulations of narrow and dingy-spirited specialists. We have still to insure that a man of learning shall be none the less a man of affairs."

This habit of strange devotion to "trivialities of literary detail," as Mr. WELLS puts it, is the fault that Professor SODDY condemns as "verbal subtleties." Hair-splitting of this sort was one of the principal activities of the mediæval universities, and undoubtedly, as Professor SODDY says, education of this kind for the ruling class of any country unfits them to appreciate the value of modern science for solving the world's problems.

However, though the arts-educated man is out of date in his thinking and painfully exasperating in his inability to understand the possibilities of the science-educated man, the lessons of the past should not be disparaged so much as Professor SODDY apparently would have us. Education by myth seems the wrong method for young men who must cope with the insistent realities of modern times, but there is much of tolerance and understanding to be gained by an acquaintance with the ancient world. When myths were the only literature of man, the human mind was being impressed in indelible ways that remain unconscious but potent factors in our nature. Habits of thinking that were formed in the childhood of the race determine our decisions today. If, as KANT said, the human mind is like a jelly-mold which transmits our experiences, much of its shaping was done in that prehistoric period when myths were current. It is not a knowledge of myths that is harmful to our ruling classes, but over-emphasis of the purely literary part of the myths and under-emphasis of the history of science in those early times. A study of the historical development of the human intelligence, with suitable stress upon the growth of knowledge in natural science, would teach a ruling class to be open to new knowledge of all kinds. The reading and discussion of man's early struggles with nature from the point of view of modern science would lead students to respect scientific enlightenment as nothing else can. The history of mediæval times—when science was so much hindered by superstition and narrow prejudice—if taught to show how science gradually lighted the way in spite of all opposition, would induce college-trained men to give every opportunity to science as an alleviator of man's burden—which is how so distinguished a philosopher as A. J. BALFOUR regards it.

The proper combination of modern science and the old humanities in education was suggested by the late Sir WILLIAM OSLER, himself a great scientist and classicist. He pointed out that the old philosophers, who are usually studied with no idea of the growth of natural science, were themselves keenly interested in physics, chemistry, mathematics, biology, geology, etc. ARISTOTLE, for instance, was primarily a biologist; PLATO was deeply interested and impressed with geometry; the old Hindus mixed up mathematics and mysticism, but were able to grasp the idea of negative numbers before the Greeks did; such a historical personage as PYTHAGORAS was

convinced that the science of numbers explains the secrets of nature—an idea to which the atomic theory of chemistry gives some credence today.

The point then is that myths and a general classical grounding are not in themselves bad influences, as perhaps Professor SODDY'S address would suggest, but that a study of the ancient world should include the history of science, and should indicate how man's blind fumblings for fundamental truths were clearel up by such scientists as DEMOCRITUS, ROGER BACON, COPERNICUS, GALILEO, DALTON, etc. The man who has been educated merely in the conventional studies of the old-time arts college is as narrow as the engineer who knows nothing of the old humanities. As Sir WILLIAM OSLER advocated, the improved education of the future should combine the old and the new, the humanities and the sciences.

Iron and Steel

Conditions in Germany

THAT the chief difficulty in the re-establishment of the German iron and steel industry is not a shortage of raw materials is made evident by the course of market prices in Germany. Scrap, which can be used very largely in lieu of iron ore or pig iron, has had a sensational decline, from a high point of 2,100 marks last March to a price of 500 marks in August, as just reported by our correspondent in Berlin. On account of the inflation in Germany and the very low rates in international exchange ordinary price comparisons are difficult, but there is a separate way to obtain information, that being to compare prices. The August price of billets is quoted at 2,365 marks, and thus we have scrap quoted at 21 per cent of the price of billets. That is an absurdly low relation, for if it obtained in the United States we should have scrap at $8 a ton on the basis of the Steel Corporation's billet price, or at about $12 on the basis of the billet price of the independent mills.

Making a comparison along another line, we have it that prices of semi-finished steel and finished rolled-steel products reached a high point last May and have since greatly declined, the declines running between 20 and 25 per cent. This seems to suggest that the iron- and steel-producing industry is finding itself able to function better than its customers.

Viewing the matter from still another angle, with the further decline in exchange, German iron and steel prices are attractive to outside buyers. At this writing we do not have available exchange rates between Germany and foreign countries, but a comparison by way of the New York rate will suffice. With the mark at 1.46 cents, the billet price just quoted is equal to about $35 per gross ton, while the plate price of August is equal to 2.38c. per pound, these being far below any prices in our own domestic market, yet we have been able to do a good export trade at prices well above our domestic prices.

Thus the internal position of the German iron and steel industry is not wholly bad. There is opportunity for exports, while there seems to be more need of the domestic demand being increased than of the ability to produce being increased.

The great shortage of coal in Germany is usually stressed, and it is quite true that the shortage is acute. We are so easy-going here that we are apt to lose sight of the fact that our own conditions are very far from reasonable. For several months past the price of Connellsville furnace coke for spot shipment has averaged eleven times its price in May, 1915, and twenty times its price in 1894. In the past fortnight there has been a tremendous decline, from $17 to $15 per net ton at ovens, so that the price now is only ten times the price in May, 1915. Coal has been selling at about ten times the price to which it occasionally declined at times within a few years before the war, or at twenty times the price some mines accepted in the late years of the last century. We have seemed to think nothing of this, but really Germany has no monopoly of having affairs out of joint. Germany has plenty of chances to recover, and there is no occasion to waste any sympathy. It behooves us rather to set our own house in order, welcoming all readjustments that may tend to produce a stable basis upon which we can conduct safe and sane business.

Cottonseed Investigations

Urgently Required

SOME months ago certain representatives of the cottonseed industries discussed with Dr. C. L. ALSBERG of the Bureau of Chemistry the problems of steaming cottonseed. Strange as it may seem, apparently no one has ever studied the effect of time and temperature of steaming cottonseed upon the yield and quality of oil and cake obtained. The industry is beginning to realize that there may possibly be some need for sound fundamental information on this important part of the plant process. As a result of the early conferences, it was decided that a co-operative arrangement could probably be made whereby the Bureau of Chemistry would work on these problems, advising in some of the investigations which are necessary upon a semi-commercial scale. The design of cottonseed machinery is involved and the co-operation of manufacturers of this equipment was fully assured. It seemed that the problem could be undertaken at an early date and valuable results could be expected almost from the start. However, there now comes a hitch. It is the old problem of the want of a few dollars, resulting in neglect and delay of the invesigation.

It seems that this industry can ill afford to permit even a month to pass without starting these studies on so promising a basis as has been proposed. Fundamental research, such as this, if guided and assisted by an experienced research organization, is almost certain to succeed. The expense would be nominal. One may properly ask why does not the industry get busy and at once provide the funds to engage a well-qualified man to take charge. If the industry as a whole cannot arrange for this work it would doubtless be profitable enough to warrant a single company in undertaking the problem.

The plant facilities required for the tests, the laboratory work for control purposes, and all the rest can easily be provided if adequate supervision is assured through the designation of the proper individual in immediate charge of the work. The industry cannot afford to let another season pass without starting these studies. The action of steam on both the cell structure of the seed and the glycerides is of the fundamental importance and is known only in a general empirical way at present. Solution of the problem will benefit the cotton planter, oil refiner and consumer.

Readers' Views and Comments

A Plea for Education of Promoters

To the Editor of Chemical & Metallurgical Engineering

SIR:—The extremely rapid development during the last few years of the industries in which chemistry plays an important part has brought into our field a type of citizen long known to us in other lines—namely, the promoter. Oil shale and platinum from "any old sands" come in for their full share of attention from this fellow, who formerly flourished in the mining game. Even the clay-working business is "honored" by his attention. I recently received an invitation to invest "with a chosen few" in a clay-working plant.

Excerpts from the prospectus as follows may be worthy of note at least from an illiterary angle:

"Are you willing to provide some of the $200,000, or more, with others in this plant?" One is intrigued by the "or more."

"My developments carry the saving in bad places farther than anyone else in the world, making it a safe business for Americans to go into—under my methods." There is some satisfaction in knowing that one's saving or savings would go far even in bad places with the methods guaranteed.

And here is another economist who settles our industrial problem, for he says: "The Government reports the immigration is landing at the rate of over 10,000 per week—this settles the whole industrial trouble—with a provision made for returning the Radicals and others." Will Emma Goldman be here soon?

And further on he advises: "The selling to retailer is the same here as everywhere, which shows a difference of there [*sic*] price from my cost of over 200 per cent while these people in this country that have grown, who have the better quality, show a difference of 100 per cent to 140 per cent and they all, here, and in Germany, sell wares that have these defects and losses . . . " But why continue? If the Dorr Company or others who have equipment for clarifying sludge on a large scale want to get in touch with this chap, I will gladly furnish his address.

Mr. Editor, I call this to your attention with the thought that you may see fit through your columns to implore the more highly educated type of promoter to give some thought to the possibilities for gain in the chemically controlled industries. Do you not know a college president or two who may be interested? As long as we have "little saving to carry in bad places" we may gain much enjoyment from the post of observation.

F. GISTON.

Future Rubber Research

To the Editor of Chemical & Metallurgical Engineering

SIR:—In connection with the suggestive article on Future Rubber Research on pages 449-450 of your Journal for Sept. 8, I wish to point out that although the adjectival description of the manager of the British Rubber Research Laboratory is correct, the writer has by mischance given my name instead of that of B. D. Porritt, who holds the responsible appointment in question.

D. F. TWISS.

Dunlop Rubber Co., Ltd.,
Fort Dunlop, Birmingham.

The Oil-Shale Industry and the Necessity for Common Sense

To the Editor of Chemical & Metallurgical Engineering

SIR:—The issue of CHEMICAL & METALLUGICAL ENGINEERING of September 8 contained two valuable articles, both treating upon Hydrocarbon Oils and Oil-Yielding Shales. William A. Hamor's writings upon hydrocarbon oils are always worth reading, but at times, when he refers to the nascent oil-shale industry, he is liable to become pessimistic. Effects often follow very closely after the cause, so it may be claimed that so long as petroleum experts thus continue to "knock" the new industry, it will be found difficult to secure the funds without which a really commercial plant cannot be constructed. But despite the knocker such plants will be constructed. The plants that up to date and upon this continent have been constructed and operated do not even begin to give the industry a fair show. The industry is one that, to be operated economically, has to be operated upon a large scale, with every process well planned.

Martin J. Gavin, who wrote upon "The Necessity for Research in the Oil-Shale Industry," has evidently lately visited Scotland and has returned so filled with Scotch methods that it would almost appear from his article that the "necessity for research" no longer existed. It is to be feared that any research undertaken by a mind so full of Scotch practice will not yield economic results. It may reasonably be advanced, from reading Mr. Gavin's article, that his visit to Scotland has, to some extent, impaired his reasoning and observation powers. Mr. Gavin states: "The Scotch retort, when carefully examined, is found to be admirably suited for its tasks." If this be so, where then is the need of research? It would be regrettable were Mr. Gavin to be taken off the research lately placed under his direction because of Mr. Gavin having already ascertained that "when carefully examined, the Scotch retort is found to be admirably suited for its task." It may, however, reasonably be asked, What can any reasonable man expect from the operations of any machine than that it should be found to be admirably suited for its task? Fortunately for Mr. Gavin and for his research, his opinion, so given, of the Scotch retort will not be accepted as correct by those interested in the oil-shale industry.

In the consideration of this most important subject, a question that probably is the most important that will come up for solution at the hands of industrial chemists and engineers during the nineteen hundred and twenties, let common sense be exercised from the commencement.

It is admitted that the oil-shale industry has for many years been very prosperous in Scotland. It is admitted that the Scotch retort, when operating in Scotland under the local conditions there existent during the last thirty years, has given the Scotch investor satisfaction as an excellent money gainer, but is it not a matter of history that the Scotch retort and process, used in other countries, where other and dissimilar conditions existed, have proved to be a failure, in one well-known case a most disastrous failure? It is advanced

that it would have been more worth while, more sensible, to have visited the scene of that failure and to have "carefully examined" into the causes of that failure than to have visited Scotland to witness the successful operation of the retort process, *working under conditions known to be very different to those that exist on this continent.* Many years' experience in planning, construction and management of large industries has satisfied the writer that it is the failures that call for the closest examination, not the apparent successes.

Should it be impossible for Mr. Gavin to visit the works of the defunct Commonwealth Oil Shale Co. in Australia, let Mr. Gavin set down and collect all the information he can concerning the most disastrous failure of the *Scotch retort and process, operating under Scotch management, constructed under Scotch direction from Scotch plans,* and then let him reason the whys and wherefores of the failure. If Mr. Gavin will do this, he will arrive at the conclusion arrived at by the writer—viz., that there are certain serious defects in the Scotch retort and process which, although not seriously operative when working under the conditions that exist in Scotland, yet under other conditions become active and dangerous.

It is admitted that the chemical principles that underlie the method of educing the oil contents of the shale (and which are employed in Scotland for that purpose) are substantially correct. It is, however, advanced that the applications of these correct principles have been in the past and are today made most uneconomically, not only in the actual applications but also as to the operation, and that under certain conditions that are known to exist the applications are unworkable. To illustrate, the following statement shows the quantity of coal used in eight Scotch oil-shale retorting works prior to the war. These works are numbered by the writer as from 1 to 8, as the management of the several works might resent having these particulars made public were the names of the works or of the firm operating also made public. In certain cases full particulars are not available, but such particulars as are available are sufficient to prove the contention that the Scotch retort is uneconomic in its operations.

COAL CONSUMPTION PER DAY IN SCOTCH RETORT WORKS

Works	1	2	3	4	5	6	7	8	Total
Shale daily retorted, long tons	500	500	1,000	720	1,008	850	764	590	5,932
Long tons of coal used:									
In gas producers	18.55	4.50	8.57	10.07	*	*	*	11	.....
Under steam boilers	66.40	30.60	57.0	*	80.0	72.0	*	*	.....
Total coal used	85	35	65½	*	80.0	72.0	*	*	.....
Tons of coal used per day for throughput of 1,000 tons shale	170	70	65½	*	80†	72†	*	*	.....

* The quantity of coal used was not given.
† Quantity of coal used under steam boilers only.

Therefore in Scotland from 65½ up to 170 long tons of coal was used per day for each 1,000 tons of shale retorted. This, at $10 per ton, means that these perfect retorts burned up not less than $655 worth and up to $1,700 worth of coal per day for each 1,000 tons of shale per day, or, reckoning 300 working days, from $196,500 to $510,000 per year for fuel. Most, if not all, of this fuel, if the retorts had been properly constructed or had been the wonderful machines claimed by Mr. Gavin, would not have been required. But to these very large annual totals must be added the cost of firing the coal, consisting of wages and repairs, the total being amply sufficient to pay a large dividend upon a good capitalization.

Mr. Gavin seems to have been filled up with claims as to the superiority of the crude oil obtained from the Scotch retort. The writer has no knowledge of the oils educed from American shale, which were compared by Mr. Gavin with the Scotch crude, but he is convinced that crude oil of as good a quality can be produced on this continent without using the Scotch retort as can be produced in Scotland when using the Scotch retort. However, capitalists do not invest their money in the oil-shale business for the honor of besting old Scotch operators, but for the purpose of securing a return from their investment, and if it is found to be more profitable to produce an oil somewhat inferior in quality, it is very certain that investors will desire that quality of oil to be produced. Research work should be directed, at first, toward the economical production of such a quality of oil as is salable at the greatest profit.

It is to be deplored that Mr. Gavin should have permitted his mind to be thus influenced before he commenced upon his research work, because it will take just so much longer to convince him of the incorrectness of the Scotch claims.

The principles that underlie the eduction of oil-yielding shales are simple, though the economic application of those principles is difficult. Oil-yielding shales, broken into pieces as small as the requirements of the circulation and of the exhaustion of the educed gases will permit, are heated in a closed chamber and the gases educed are drawn off and are passed through condensers to recover the oil. The gases are then washed in scrubbers to recover the naphtha and the ammonia contents.

Temperatures that are higher than the maximum absolutely necessary for eduction *must not be used* if the maximum recovery of oil is desired, and the educed gases should not be exposed to a temperature higher than that at which they are educed.

These governing principles are very simple, but their economic application to retorts is a matter that requires much engineering knowledge and experience. This economic application is encompassed by many difficulties and too often we escape from one only to be met by another of even more importance. These difficulties are not only scientific in their character, but they are also economic, hence there should be associated with the research chemist an engineer.

The writer claims that under American conditions the Scotch retort and process are unduly costly to construct and to keep in repair, that they are immensely wasteful of heat units, that they cannot be operated without the use of large quantities of steam and that there are localities where the necessary water is not available. In such localities, were the Scotch retort to be used without steam, the resultant yield of oil would be comparatively small and the quality poor. In fact the Scotch retort is unworkable without the employment of large quantities of steam. The retort, as it is now operated, seeks to recover, in one operation, a full yield of oil and also of ammonia and it is a well-known and admitted fact that dual purpose machines are never noted for maximum yields. Maximum yields require the employment of two specially designed machines.

Let the deadly parallel speak. Let it be seen how far the Scotch retort that is claimed to be "so admirably suited for its task" conforms to the standard of perfection.

THE PARALLEL

	Standard of Perfection	Scotch Retort
Construction	Should be so designed that it is capable of being quickly constructed. The material required for construction should be readily procurable on the American continent. It should be capable of being constructed by such labor as is available at or near the locality where the retort is to be erected.	Requires very considerable time for construction. Much of the material required is special and may have to be imported, at great cost, from Europe. The labor also will, to a certain extent, have to be imported and is hard to secure even in Scotland.
Cost of Construction	Should cost *per ton throughput* as little as possible.	Exceeds many times, per ton throughput, the cost of several of other designs of retorts.
Production or Throughput	To secure economy in the cost of the construction of the retort it is imperative that the shale should not require to remain in the retort too long a time. It has been demonstrated that the oil can be educed when the shale is exposed to heat for only one hour.	Very slow throughput. The Scotch retort requires the shale to remain in the retort from twelve to eighteen hours.
Feed Into Retort	Constant	Intermittent
Discharge From Retort	Constant	Intermittent
Application of Heat	Should be arranged so that each and every particle of shale being retorted shall receive identically the like heat treatment.	Shale located next to the walls of the retort is subjected to much higher temperatures and for a much longer time than is the shale located in the center of the retort. To subject the shale in the center of the retort to the required temperatures, the shale located at the sides of the retort must be overheated and burned.
Removal of the Educed Gases	The educed gases should be removed from the retort as soon as educed and in no case should they be subjected to high temperatures.	The educed gases before removal have to be exhausted through the whole length of the retort. It is because of this that steam is required to be used so that the removal of the gases may be accelerated.
Yield of Oil	Should be the economic maximum. It is seldom commercial to secure the maximum.	Claims to recover the economic maximum, but no proofs have ever been advanced that it does so.
Quality of Oil Yield	Should be as high as possible without interference with economic results.	Claims to recover oil of high quality, but no justification has yet been advanced which warrants the presumption that oils of as high quality cannot be educed from the same shales when using other makes of retorts.
Condensation	The condensation of the gases exhausted from the retort should be so arranged that the conditions under which condensation takes place are the same during the night as they are during the day and the same during the coldest day in the winter as they are during the hottest day in the summer. In Canada the difference between minimum winter temperature (that is, more than 32 deg. F. below zero) and the maximum summer temperature (that is, over 95 deg. F.) is over 127 deg. F. While the differences of the temperature in Colorado may not be as great as that experienced in Canada, yet they are much greater than in Scotland.	In Scotland the educed gases are condensed in condensers using atmospheric air condensing. In Scotland the variation of the temperature of this atmosphere is probably within 80 deg. F. Condensers using atmospheric air condensing are also very irregular in their operations, through the constant variations in the strength, humidity and direction of the air currents. With such variation of temperature and of air currents, how is it possible to secure satisfactory condensation?

THE PARALLEL—Continued

	Standard of Perfection	Scotch Retort
Heat Conservation	Should be most carefully considered. The retort should be designed and operated so that perfect heat efficiency and heat conservation can be secured. The retort should be so operated that the forced gases produced will be sufficient to provide the heat required to heat the retorts and also required to produce the power to operate the works. The efficiency possible from the combustion of washed gases is so much higher than the possible efficiency from the combustion of coal that there is no economy in most cases in purchasing coal to use in place of fixed gases.	Heat conservation is almost entirely ignored. The losses—avoidable losses—of heat are very great. The heat efficiency of the gases burned in the combustion chambers of the retort is very low, as is also that of the coal burned under the steam boilers. All the heat contained in the educed gases is lost. As an example of wasting heat, nothing more wasteful can be instanced than the Scotch retort and process.
Area Covered by Works—Cost of Wages	It is an axiom with industrial works planners that the works shall cover as little ground as may be possible providing fire and transportation requirements are considered.	The Scotch works, etc., cover several times the ground area necessary, thereby *increasing the labor and overseeing* charges and increasing largely the cost of pipes.
Durability	The works should be so designed that the cost of repairs, and the loss of operating time consequent to such repairs, shall be reduced to a minimum.	The Scotch works are generally not good examples of works planned so as to require a minimum of repairs, but as each works would require to be criticized separately, it is not possible to particularize.
Regulation and Flexibility	The retort and other machinery should be so constructed that the application of meters, thermometers and pyrometers (plain and recording) and of pressure gages and gas recorders may be possible. Nothing should be left to the personal factor or other "rule-of-thumb" method, as is largely the case in Scotch practice. From first to last the process should be precise and yet capable of variations, as required to retort economically the variations in the quality of shale that from time to time have to be retorted.	In the Scotch retort and process the success of operations is left to the judgment of one or more men who have to rely upon their eyesight, their judgment and their experience. Such a system of operating may be possible but never desirable in locations where operations have been carried on for a long term of years, but such a system would not be economic when operating a new industry located in a new country, nor would it be possible.
Topping	Although topping is not a process that is a part of retorting, yet as topping may be a process that may be required under certain local conditions to be added to retorting, it cannot be ignored. With improved methods of retorting and condensing it is possible to make alterations in the present method and for topping that not only save expense but will produce better fuel oil and a larger yield of gasoline and kerosene.	The Scotch process is governed by their methods of condensing which prevent the employment of certain economical methods of "topping."

To illustrate the objection made to the Scotch retort because its operations are regulated by the human factor, the following anecdote current in dairy farming circles is given.

A certain dairy farm manager, who rightly had a reputation of being a good judge of milking cows (he was Scotch) resented being obliged to weigh the milk given by his herd of cows every night and every morning.

After three months' experience of the proper recording of the milk given by each cow, the expert voluntarily owned up that he had been wrong. He was frank to acknowledge that he had believed he could judge a milch cow and that he knew for certain which of his cows yielded the most milk, but that since the milk had been weighed night and morning he had found out that certain cows he had judged to be his best were not his best and that certain other cows he had esteemed but lightly had shown up to be among his best cows. So much for the human factor. Personal observation and experience are valuable, but the results obtained by the use of the personal factor cannot be compared, for accuracy, with the results of regulation by exact measurements.

In concluding, it is to be hoped that Mr. Gavin will, at first, confine his research work to the determination of essentials and will leave the "frills" for investigation when the difficulties that concern the essentials have been elucidated. His program is a large one, so large that it is important that today's practical problems should first be investigated.

LOUIS SIMPSON.

Ottawa, Ont.

What Shall the Government Do With Its Employees' Inventions?

An Explanation by Dr. Alsberg and Dr. Cottrell of the Conditions in Government Laboratories Which Led to the Drafting of Senate Bill 3,223 Authorizing the Federal Trade Commission to License Patents Granted to Government Employees—Objections Brought Out in Open Discussion

THE following report is a selection of the salient statements made at the meeting at the Chemists' Club, New York, called on Friday evening, Oct. 15, to discuss H.R. 11,984 and S. 3,223, bills for granting the Federal Trade Commission the power to receive assignment, administer and license patents on inventions made by Government employees. The original bill has passed the Senate, and can be brought up in the House on the call for the report of the committee at any time, placed on the calendar, and acted on—passed or turned down entirely or amended; it can be amended in exactly the form it stands as having passed the Senate the second time, and then if it is passed just as it stood in the original measure, it will go to the President, having passed both houses. The Federal Trade Commission was chosen because it was felt that this body was already in a position to handle such matters, while the creation of a new agency would involve duplication of effort.

David Wesson presided and opened the meeting with one of his characteristic bearing-on-the-subject stories. He then drew an analogy between the Government and a corporation, which he noted could not handle its business like the former and survive. He continued:

"Attention has been called to two plans for improving the financial conditions of Government scientists. Perhaps we have not been correctly informed about the details of these plans, but as stockholders in our great United States Government corporation we are very much interested in them. As the matter has been put to your chairman, it would appear there is a proposal on foot to allow scientists in the employ of the Government to have the opportunity of working with the Government's resources and on the Government's time to develop inventions at the expense of the stockholders of this great corporation about which we have just been speaking. It also seems to have been understood that the Government proposes to take out and control patents for the benefit of the employees of this big corporation in which we are all stockholders. If these are the facts, they are certainly very objectionable for various reasons. In the first place, it is well established by decision and precedent under the U. S. patent law that inventions by an employee using information and facilities of the employer belong to the latter. This, of course, would put employees of our great United States corporation in a separate and privileged class.

"Again, the Government employees who are scientists would naturally have privileges which those who are not scientists cannot possess.

"There is no doubt that a law permitting individualization of Government-made inventions would make Government service very attractive and it is possible to conceive that the old saying 'a public office is a private snap' would become truer than ever."

The Problem of Dealing With Government Inventions

By Carl L. Alsberg

It has always seemed to me a great pity that so many of the things that are done in the Bureau of Chemistry and in the Government services generally incidental to other work lie unused in the archives of the scientific press or in Government bulletins, and I cast around for a way to make such work really useful to the people of the country. Analyzing the situation from day to day, in the course of years I began to realize that the average research man, in the Government service at any rate—it may be different in the industries—is a rather impractical sort of person.

The Office of Development Work

It seemed to me that the only thing to do was what was being done very largely in industry, to separate to a certain extent the development and practical application from the research, and for that purpose I grouped together a few young engineers who had been in the service of the bureau for quite a while and who have made good in a great variety of ways during the war, and called them the Office of Development Work. Their job is to take anything that happens to turn up in connection with the research work or other work of the bureau that looks like a useful discovery and that might have some practical application, and in the language of our present secretary, who is an advertising man, sell it to somebody.

It is not proposed, as the press has stated, to take up anybody's invention and develop it, nor is it proposed to do any work for anybody excepting the Bureau of Chemistry's technologists, and possibly for certain other scientists in the Department of Agriculture.

Should Chemical Work Be Centralized?

Now, any organization by fundamental sciences—and I take it that Dr. Wesson's suggestion that all the chemical work be grouped together in one organization is a suggestion in that direction—in the Government service, in my judgment, is just as wrong and impossible as the organization of research in a large industrial corporation by fundamental sciences. Congress does not appropriate money to advance human knowledge. If we advance human knowledge in the Government service it is incidental. Congress appropriates money for the solution of certain very definite and practical problems. It may be a problem involving the utilization of waste land, it may be a problem involving the utilization of some waste agricultural product, it may be a problem involving the prevention of disease and the improvement of the public health, but it is always a practical object, and the Congressman sees in terms of practical things.

That being so, the purpose for which money is appropriated by Congress, the objects for which we work being thus, what would happen if you grouped all the chemical work in one place? This would happen: You would expect a mining engineer to send his work, his chemical analyses, to a central laboratory. He does not know who does the work, he cannot be sure that it is going to be done by a first-class man; it might be done by a second-rater. The man who wants the chemistry of a serum studied, or the chemistry of bacteria in connection with the public health problem, has got to send his work to the same place. Fertilizer work has got to go to the same place; paper and pulp and metal and steel; and it has all got to be done without any special reference to the particular object in view.

Government Inventions Are Incidental to Research

You must not go away with the idea that we people in the Government service are at work for the purpose of making inventions. Most of the work that is going on is of two types; it may be research designed to advance the enforcement of some statute, as for example the enforcement of the food and drug act—we are carrying on in the Bureau of Chemistry a great amount of work on methods of analysis of foods and drugs, in order that we may be able to detect sophistications of various kinds. At the same time our people are in constant touch with these industries; they see problems that the industry is not aware exists; they see inefficiencies and wastes that the men in the industry, because they are so close to them, do not see. They may in that way develop processes or inventions that are of benefit to the industry, incidental to their law enforcement work.

There are other inventions that are made which are purely incidental to fundamental research. A man is engaged upon some fundamental research, and incidentally, as a byproduct, develops something of use. And there are inventions that are made in connection with what I call the small industries, industries like farming, canning and making turpentine, which are small and must remain small, must be broadcast over the land; inventions which are absolutely necessary and which would be done by no other agency.

Example of Calcium Arsenate

Take, for instance, the discovery of a new insecticide. I have in mind, for example, the use of calcium arsenate in combating the boll weevil, for it seems that thus we have a means by which the boll weevil may be kept down. Such an invention would certainly never have been made by any manufacturer. In the insecticide and fungicide industries the manufacturers have, and have always—and I can say that with some knowledge, for my father was a manufacturer of insecticides—trailed the agricultural experiment stations and the agricultural colleges.

Now, we took out some patents on calcium arsenate. We applied for a patent for every conceivable method that we could figure could be used to make calcium arsenate, and we did that very deliberately. We did not care whether a patent was granted or not, we wanted to prevent somebody else from getting it, because we did not wish to have repeated the experience with lead arsenate, which was discovered by scientists in the Government and state services as valuable for insecticidal purposes, and the manufacture of which, a rather simple matter, was patented. We wanted to prevent some one coming along and patenting the method of making calcium arsenate, the real discovery not being how to make calcium arsenate—anybody can do that—but the discovery being that calcium arsenate is a valuable insecticide.

Most of the applications were thrown out by the Patent Office, just exactly as we anticipated, but having made the record we don't care. Actually the calcium arsenate is now being made by one of the methods that have been patented under Dr. Haywood's name, and of course everybody is using the method and nobody is paying tribute for the use of the patent.

So that, at least in the Bureau of Chemistry, is the way most of these inventions develop. There is not a deliberate attempt on the part of anybody, or has not been in the past, to invent something; but a man is engaged in some law enforcement work that deals with some industry, he sees an inefficient method or a waste in that industry—and there is an awful lot of it in the food and drug industries—and he has an idea how that inefficiency may be rectified or how that waste may be used. He does some work which leads to an invention; but he is engaged upon fundamental research, and incidentally he runs into something of value.

What Is to Be Done With These Inventions?

For example, one of the chemists in the bureau was interested in the organic chemistry of xylose, and he looked about for a convenient and cheap source of xylose. He found that he could get very easily 15 per cent of xylose calculated on the dry weight of corncobs. He made a little of it, he made the derivatives that he was interested in, and incidental to that work discovered that there were a number of useful things which you could get out of corncobs, such as 3 per cent of acetic acid and 2 per cent of furfural, and 30 or 40 per cent of an adhesive as good as many grades of dextrine. What would you have him do with it?

Explanation of the Bill

By Frederick G. Cottrell

The bill has appealed to the public very largely as a bill to provide compensation for Government employees who may take out patents. It has appealed to the public in many cases as that being its prime object. That is rather a natural way for it to appeal to the public, because the public thinks of patents in general in that personal way, of the effect on the patentee, the inventor; that is, as a means of rewarding the inventor as the sole object of the patent system. I have tried to develop, in what I have said tonight, a sense of the other point of view, that the really important thing, the thing that justifies our patent system today, is not so much the return to the inventor, no matter how laudable that is and how important that is, but the thing that affects the public as a whole with me is the efficiency that the patent system has attained in getting new things through to the general public and reaching a far larger number of people, and more effectively, more powerfully, than it possibly can the small group of inventors. In other words, from a public standpoint the patent system is justified not by what it returns to the inventor primarily, but what it does for the public in getting things through more efficiently, and representing greater progress to society as a whole.

Just so in this bill there is an element of possible reward to the inventor, but the important thing in it, to those of us who had to do with its framing and its carrying through to the present point, is in making more effective the material that is developed primarily in the Government service, in the Government laboratories, bringing that thing through to the public, so that the public at large will stand a better chance of getting material benefit in their everyday life eventually from those discoveries. Incidentally, if we can encourage the workers in the Government service to keener efforts in that regard, and give them a fairer deal in that, so much the better. But of the two points the first one is by far the more important, and I for one should be perfectly willing to see the return to the inventor entirely wiped out of that bill rather than see the other sacrificed, because there are other ways in which that can be done, through recognition in promotion, salary and so on, as it is now. I have looked upon that as a very small incidental to the whole matter.

I was not surprised that that point of view was missed, as I say, because it has been so much the habit of the public to look at the individual effect; the inventor stands up in patent work as an interesting factor, he is always a rather picturesque character which appeals to our emotional side, and is played up in every story of invention; whereas the humdrum working out of the invention in the multitudinous fields of industry and through those channels is a thing that is so generalized that it does not make very good material for the popular writer, and we are not so apt to think; we do not think in generalities quite so much. We think in personal terms much more easily.

Perhaps I might read the bill, with that much introduction, so that you will get the text of it, at this point.

The following shows the text as passed by the Senate March 22, 1920, and as amended by the Senate in Section 10 of H. R. 11,984, June 4, 1920.

Matter in brackets is matter cut out June 4; italicized matter is matter added June 4 by the Senate. When read, by ignoring bracketed matter and reading italicized matter, you have the bill as it will go to conference in December, 1920:

Section 10—That the Federal Trade Commission be, and hereby is, authorized and empowered to accept assignment of, [or license or other rights or powers under, to develop, to issue or refuse to issue licenses under, to encourage the industrial use and application of, and otherwise administer,] on behalf of the United States under such regulations, and in such manner as the President shall prescribe, inventions, patents and patent rights which said commission deems it to the advantage of the public to be so accepted, as these may from time to time be tendered it by employees of the various departments or other establishments of the Government [or by other individuals or agencies;] and to co-operate, as necessity may arise, with scientific or other agencies of the Government in the discharge of the duties herein set out, and the Federal Trade Commission is hereby authorized and empowered to *license and* collect fees and royalties for licensing said inventions, patents and patent rights in such amounts and in such manner as the President shall direct, and shall deposit the same with the Treasurer of the United States; and of the total amount of such fees and royalties so deposited a certain percentum, to be determined by the President, shall be reserved, set aside, and appropriated as a special fund to be disbursed as directed by the President to remunerate inventors for such of their inventions, patents and patent rights contemplated by this section as may prove meritorious and of public benefit; *provided, that nothing herein shall be construed to give said commission or any other governmental agency any authority to engage in the manufacture of any such invention or patented article.*

The Commissioner of Patents is hereby directed to grant all patents and record all assignments and licenses contemplated by this section without the payment of any fee.

You will notice that the Federal Trade Commission is not obliged to accept all that is presented to it. It can simply choose those that are worth while. In that way it can reject and leave out those patents that it thinks can run on their own feet, the things that do not need nursing to go through into the industry.

There is nothing in the bill making it mandatory that any department or any individual shall turn these things (inventions, patents, patent rights) over.

It says various Government departments, "or by other individuals or agencies." That "other individuals or agencies" has been adopted, too, as broadening the scope beyond the Government field; the reason for that being put in in the original bill was to give an opportunity to carry out in this same way the work that is often done between Government departments and private industries, in co-operation.

LEGAL SIDE OF THE PATENT QUESTION

The clause "and to co-operate as necessity may arise with scientific or other agencies of the Government in the discharge of the duties herein set out" means simply that it is not intended that the Federal Trade Commission shall go to work and build up, within itself, a great system of scientific bureaus developing new inventions or carrying them on beyond the point. They shall administer simply the legal side of the patent question, the side of the business economics of it. In the Bureau of Mines we are interested, for example, in developing certain technical results. When we get the technical results we want that to go out into the industry. We are willing to follow the technical results and help the industry in the technical details, but we do not want to have to go out also and build up a legal bureau to study the proper relationships of these patent regulations. That is a function directly of the Federal Trade Commission, and there is where we can co-operate to a very great extent to avoid this duplication that we are speaking of.

ALL PATENT RECEIPTS TO BE POOLED

The matter of licenses, fees and royalties is a subject that cannot be worked out on the floor of the houses of Congress by general discussion; it is an economic study, it is the same sort of thing that they come to in the bureau matter, of referring that sort of study to a man who can sit down in quiet and study it as a scientific problem, and arrive at scientific methods of distribution. This is intended to indicate clearly that the return to the individual inventor is not necessarily in proportion to the amount of royalty received on that particular patent; the funds from all patent receipts are pooled, you notice. It goes into the general treasury, except for a certain percentum of the whole that is set aside for a reward. The only thing that is determined there, in the early part of the procedure, is what proportion of the total receipts from all the patents is a fair thing to be set aside as a stimulation fund for the inventors, as a recompense for this sort of work.

My own feeling is that the distribution of that particular percentum among those who receive it should be placed in the hands of an entirely separate body from the Federal Trade Commission, and should be disassociated from the body which actually does the business work.

For example, suppose somebody invents or works out and patents a therapeutic serum or other medical preparation, that from the very nature of the case is produced and sold and carried through at a minimum of cost, and reaches a comparatively small number of cases, from which the monetary reward is very small, but the saving of life and the effect on the nation is tremendously important. And alongside of that comes somebody who incidentally invents some little part of a piece of farm machinery, perhaps, in the regular course of his duties in road work or dairying or something of that kind, but that happens to be handy and convenient but of no immense significance, but happens to go into a large manufacturing field, and from the initial license happens to develop a very much larger fund than was expected from that. Fundamental justice in that thing, viewed broadly, would sanction the distribution of the reward between those two inventors, from this general pooled result, in entirely different proportions from the actual returns derived from those particular patents.

Another thing, if you pool them in that way, it takes away largely this feeling of fear that the Government employee will be apparently dominated by a commercial spirit to run after the things that are going to make money.

Discussion

Discussion was opened by R. P. Perry, who spoke in part as follows:

Dr. Cottrell and Dr. Alsberg have outlined in a very interesting way an explanation and some justification of the proposed departure.

One ostensible purpose of this departure is to aid chemical industry by Government co-operation. My own analysis is that it will do just the reverse—that is, it will hurt chemical industry by Government competition.

Our genial speakers have told us that we are mistaking their purposes and misunderstanding their aims. Perhaps so, but it is rather surprising that we who have made chemical industry our life work should not be able to understand a plain proposition even if the somewhat devious ways used in securing authority and appropriations from Congress surround the plan with considerable haze.

Disregarding the very real political difficulties which are bound to develop when the Government enters the commercial field even in a developing or advisory capacity, I make the point that the proposed departure takes the Bureau of Chemistry from its proper sphere of standardizing materials and methods of testing.

Development Work Leads to Manufacture

The first step did not look very far reaching, but see how it led to the next. A Bureau of Chemistry employee patented a process and the bureau consented to license manufacturers to use the process, as to which license I will say a word in a few moments. They found that a laboratory process did not get very far, and so it is now proposed to have a small experimental plant and an engineering force. They will next find, as we in industry know, that small experimental plants do not go very far and they will want a larger scale operation. This will inevitably produce material in commercial quantities, and may be expected to lead to sales of the products to other Government departments, and perhaps to the public in competition with private manufacture, and the proceeds used to extend the work.

Such a development of semi-commercial or commercial manufacture may also be expected if the bureau finds, under the necessary surrounding conditions, that chemical concerns are loath or slow to co-operate on the Government terms, and the bureau may then feel itself driven to save the industry against itself by not only showing how it can be done but also doing it—at the taxpayer's expense, including of course the chemical industry's tax contribution. Mark, too, that the public notes say, naïvely, that "for the present the work will be confined to discoveries made in the Bureau of Chemistry." A later logical step would be to extend the work to many other lines.

It seems to me clear that by this departure the Government will lose its position of impartial judge and compete with business. Being supported by the taxpayers, it will compete on an unfair basis, and, wishing appropriations from Congress, it may be led to show or attempt to show fictitious profits.

The Case of Phthalic Anhydride

Speaking of fictitious profits, CHEMICAL & METALLURGICAL ENGINEERING of Oct. 6 quotes from a recent address of the Secretary of Agriculture, telling of the large savings to American industry due to a single discovery in the Color Laboratory, "the catalytic oxidation of naphthalene to phthalic anhydride," which it is stated results in a saving of $700,000 per year compared to the old German process. We in the industry have tried to figure this saving of $700,000 per year, but cannot come within a mile of it, but that is not the whole story.

I do not wish in the least to detract from the work of Dr. Gibbs and the Color Laboratory in discovering this process, but it is not a fair statement to set out this process and the alleged saving as a justification of the proposed line of development work. It may interest some of you to know that two other parties apparently made the same discovery considerably before publication of the Bureau of Chemistry results, one a German of the Badische company and the other in our own laboratory. This important process would not have been lost to the United States if it had not been for the work of the Color Laboratory. Do not misunderstand me. I do not wish to belittle in the least their work, but I do say private industry was on the trail and found the same process about the same time.

Difficulty of Licensing Patents

And this phthalic case brings up another point which shows the difficulties bound to develop when the Government tries to go into the licensing of patents. It endeavored, undoubtedly in good faith, to develop a fair license to secure the co-operation of private companies in manufacturing phthalic, and offered a form of license to us. The form which I have here is too long to analyze in detail, but it contains, among other things, a provision which requires any concern taking a license to turn back to the Department of Agriculture, and indirectly to the public, any new and patentable process developed during the course of the co-operative work. We criticised this clause as being manifestly unfair, and although two new editions of the license form have later been submitted to us this clause remains the same; and yet it appears that in one case at least the department waived this clause to another concern without notifying us of its change of base. A slip, you may say, but it is a very bad thing for the Gov-

ernment to slip when setting out to deal with the public on one uniform set of terms.

There are many other objections to specific features of the plan, but I have already taken more time than I would wish and will gladly leave it to others to develop the subject further. I do hope that all will grasp the significance of the proposed departure and what it will logically lead to—the Government in competition with private industry. I know industry does not want it and I do not believe the American chemists, or the American people, want it.

E. A. Sperry said: "I think that any such proposition will grow on and on in point of socialistic control, which I very much hate to see advanced in the slightest. I hope it will die in committee good and dead, I am sure."

Mr. Husted, Dr. Weston, Mr. Deppe and Dr. H. E. Howe also joined in the discussion.

Reply by Dr. Cottrell

In replying Dr. Cottrell said in part:

I do still feel that work of this kind has a distinctly constructive point of view, and the big things that I should hope would gradually come out of this bill—not immediately, but in the long run—would be a careful study and clarification of the whole patent administration, from a bigger and broader standpoint than perhaps it has been approached from today.

I do not feel that the knowledge or the judgment, in the application of these matters, of those who have it in charge, those who are working with the problem now, is by any means infallible. We are learning as we go along.

This whole bill was framed as carefully as we knew how to frame it, as an enabling rather than a mandatory act, so that those mistakes would correct themselves as rapidly as possible, and as much pressure could be brought from the outside in trimming up and working with that as possible. If there is any way that that can be put into safer and more guarded terms I hope you will work with us.

I am glad that one of the speakers brought out, or suggested, a point that I forgot, or at least a point that should be mentioned, as one of the dangers not only in this bill but in connection with Government work in general. That is the research bureau's tendency to work in too close to what we may call the normal advancing front of industry, a tendency that is very naturally human, to look for credit and the easiest credit, to try, sometimes unconsciously, to reach for the thing that is just going over the hill, it is just going to succeed, and grab it before it goes over and let it tow you through. That is a tendency that we have got to fight all the time, and we have got to rely on the people of bigger vision to try to inspire that sentiment in the worker.

Somebody spoke of this bill authorizing the Government employee, in getting in and co-operating with the industry, to take the results of what he found in industry and come out and patent it in the Government service. I fail to see, frankly, just how that applies to the concerns that we are working with in our Government work. We find where we have worked with them pretty closely that there is a certain large group of patents that they are quite willing to co-operate with us on. There are certain others that they do not want to co-operate with us on, and very properly so. Now this bill is not intended necessarily to apply to every patent that is ever taken out or that might be taken out. You have got to realize that no piece of legislation of this kind is universally applicable. There is another reason why we made it simply a permissive measure; where the thing fits in and will help to forward an industry, everybody has a chance to set down and work that out. If somebody wants to co-operate with a Government agency in doing this work, in some such form as this, quite well and good. If they do not want to, there is no reason for bearing down. Yet it is the permissive feature of the legislation that I would like to emphasize. It is a question for experimental work. It gives us a chance to try the thing out and determine in actual practice what is possible.

Reply by Dr. Alsberg

Several important points were brought out in Dr. Alsberg's reply.

If we have some men at work on fundamental problems and if they are any good they are going to get things that will have commercial value, and you cannot stop them. What will we do with those things? Publish them? Patent them and forget them? Patent them and endeavor to have them used? And what is the machinery that should be devised to have them used?

I quite agree with those who have said that we should not turn the Government into a machine for doing industrial research, but I believe firmly that too much fundamental research cannot be done, and that there cannot be too many places in which fundamental research can be done. The industries do not do it. Tell me, how many chemical concerns in the United States have done fundamental research that has been published for the benefit of scientists generally? You can count them on the fingers of one hand. There are such places; there has been some wonderful work done in two or three; but that is all there are. The fundamental research, the research that makes new industries possible, real progress possible, is not being done in the industries themselves, and it should not be done there, as a rule. It is being done in universities, it is being done occasionally in the Government service, in this and in other countries.

Further Discussion by Dr. Cottrell

In conclusion, Dr. Cottrell added a few points which he felt had not been made sufficiently clear.

It is recognized that on those things that are natural monopolies you have got to figure for control, and work it out as a public service matter. There are not a great many patents, I grant you that, that meet that condition; that need this regulation, need that application of this law. There is a great deal of material that can be handled just as we do now, by publication without patenting, or we may go a step further and use our present method of patenting and dedicating it to the public, where we know that the thing fits into industry so well, without any further or any new risk of capital, that all you need to do is to get it well on the market, and see that there is no monopoly, and everybody will go ahead and use it. But there are a great many things that need a certain degree of protection in order to carry them through the first stage, and this bill is primarily to work upon that material. Now if it is too broad, if there is danger of other things, let us try to define that and try to educate the people up in administering to that.

American Iron and Steel Institute

Account of the Eighteenth General Meeting Held Oct. 22, 1920, With a Review of the Technical Papers Presented—Blast Furnace, Basic Open Hearth, Residual Manganese, Copper Steel and Alloys for Automobile Construction Were Discussed

JUDGE GARY addressed the usual large assemblage of men interested in iron and steel, at the eighteenth General Meeting of the American Iron and Steel Institute, held in New York City, Oct. 22. The greatest part of his address covered an account of a recent trip through Belgium, France and Spain. After paying a glowing tribute to the American soldier and his effective aid in ending the war, prompted by a pilgrimage in the path of the American Army, Mr. Gary gave his impression of the industrial outlook in France and Belgium. Generally speaking, he said, the people there were extremely industrious, grimly determined and making good progress toward rehabilitation, indeed much better than one would expect, despite the fact that from one-half to two-thirds of their young men are gone, victims of German kultur.

Then passing briefly to the business outlook in America, Judge Gary said that as far as he could see there were no clouds in the sky at the present time nor were there any dangerous storms to be predicted in the near future. The decreasing volume of sales and lowering of selling price he regarded as an extremely good indication, inasmuch as nearly every line has been up to now unable to supply the demands for its product. Prices in general are outrageously high, especially as regards middlemen and some classes of employees. Mr. Gary, however, made it very plain that this statement should not apply to the wages paid to the average workman. Consequently, in his opinion, the average of the general scale of prices ought to be reduced, and the present tendency is toward a lower basis, notwithstanding the fact that every individual is willing for all others, besides himself, to make large reductions in their asking price.

Recent Developments in the Iron and Steel Industry in India

C. P. Perin discussed "Recent Developments in the Iron and Steel Industry in India." In ancient times India produced a considerable quantity of extremely high-grade iron and steel products, but until within very recent years no modern developments for commercial output of these products have been successful. About fifty years ago a steel plant was erected in Bengal, which at the present time is operated by the Bengal Iron & Steel Co. Its steel plant and rolling mill have been down for several years, but the company is making cast-iron pipe and track chairs with the product of four 80-ton blast furnaces.

About fifteen years ago some Indian capitalists headed by Mr. Tata became interested in the possibility of developing an Indian iron industry and instituted a survey to determine just what the country's resources were. Extraordinary quantities of the highest grade iron ore have since then been located. Over 20,000,000,000 tons of iron ore has now been located with a fair degree of probability, within an average of about 150 miles of the coal regions. Unfortunately, however, coal has not been located in sufficient quantity to smelt nearly this amount of iron, coking coal being especially rare, only 2,000,000,000 tons of this having been found.

The coals are low in sulphur but high in phosphorus and ash, the best coals running 12 per cent of ash and this ash analyzing 1 per cent of phosphorus. At the present time, for instance, the Tata Works are using Coppe non-recovery ovens, the coke running from 17 to 20 per cent ash—a fuel which would not be looked upon with favor in America. However, a reasonable blast-furnace production is possible on account of the extremely high grade of iron ore, it containing little or no silica. The plant comprises two blast furnaces which were expected to produce 250 tons of iron per day, but actually are turning out 375 tons. The company has also constructed four 40-ton open-hearth furnaces, a combined railroad and structural mill, and several merchant bar mills. This plant was operating successfully in 1913, after several years of construction and preliminary operation.

A company called the Indian Iron & Steel Co. has two modern blast furnaces under construction. Its ore deposit contains 100,000,000 tons of 65 per cent ore. There are also two other iron companies in the formative stage at the present time. In view of the astounding reserves of exellent iron ore and cheap labor, available at from 20c. to 30c. per day, there seems little reason to doubt that within the next decade India will be able to export iron and steel products to many parts of the world.

The Basic Open-Hearth Process

"The Basic Open-Hearth Process" was discussed by F. L. Toy, superintendent of the open-hearth department of the Homestead Works, Munhall, Pa. Mr. Toy's paper was a general discussion of the furnace and its construction from an operating standpoint, and a consideration as to whether it could not be largely improved from both a mechanical and a metallurgical standpoint. It was pointed out by the author and others speaking afterward that the present construction is far from efficient; and is largely the evolution of years of experience. Changes have been slow, in a few cases the result of engineering analysis, but in the great majority of cases as a result of "cut and try," consequently the final result is due more to the operator than to the engineer.

An approximate heat balance of a modern open-hearth furnace is as follows:

	Per Cent
In the melted metal	14.0
In molten slag	3.3
Absorbed in reduction and other chemical reactions	2.8
Radiation loss	17.3
Going to the checkers	62.5

This gives a net over-all efficiency of slightly ove

20 per cent. Of the 62.5 per cent heat going to the regenerators, 4.5 per cent is lost between the checkers and stack, while 34 per cent goes up the stack.

Efficiency in regenerators as ordinarily constructed is much lower than the thermal efficiency of blast-furnace stoves, ranging from 20 to 38 per cent. Extremely low efficiency in checker work may be expected where the furnace layout is built to fit a site rather than vice versa. Mr. Toy was understood to advocate a change in regenerator design to approximate that of a blast-furnace stove, but some of his critics took sharp issue with him, holding that the extreme high temperature and dust content of the gas entering the open-hearth checker work presented so much more severe conditions that a blast-furnace stove would need to be modified to a point where it could hardly be recognized.

Residual Manganese

A comprehensive discussion of the use of high-manganese iron in basic open-hearth practice was given by E. A. Wheaton, superintendent of the open-hearth department, Bethlehem Steel Co. The whole discussion revolved about the greatest problem now before the American steel maker—namely, a sufficient supply of low-sulphur fuel. Mr. Wheaton's contention was that iron high in managanese could come from the blast furnace high in sulphur and yet produce open-hearth steel containing residual manganese, low sulphur and oxygen, and excellent in quality. Bethlehem Steel Co.., in an effort to solve the sulphur problem, operated its No. 3 open-hearth for several months on material which must undergo the severest inspection, and records for this furnace have furnished information for Mr. Wheaton's paper.

TABLE I. LOSS IN SULPHUR BETWEEN BLAST FURNACE AND OPEN HEARTH

No. of Tests	Average Mn at Blast Furnace	Average S at Blast Furnace	Average S at Open-Hearth	Per Cent Loss in S
21*	1.39	0.09	0.04	53
89	1.72	0.07	0.035	50
26	2.13	0.07	0.031	57

*Contains a number of high-sulphur casts. Low manganese must be held longer in the ladle to effect desulphurization.

When a blast furnace works on an ore which will furnish hot metal containing 2 per cent manganese, sulphur may run as high as 0.1 in the pig iron without danger. This means that lean slags may be run with a correspondingly low coke ratio, which in itself is a considerable advantage. High manganese causes an elimination of at least one-half such sulphur during the 80 min. the hot metal is en route from blast furnace to open hearth. Figures covering over 100 tests are accumulated in Table I.

Silicon must be low, below 1 per cent, for this elimination of sulphur, since apparently in high-silicon irons manganese sulphide reacts with $FeO.SiO_2$

$$MnS + FeO.SiO_2 = FeS + MnO.SiO_2$$

If SiO_2:MnO = 0.8 in the mixer slag, good removal of S in the mixer will occur; in these tests it averaged 0.006 per cent.

Open-hearth operators are opposed to high-manganese charges on the ground that they decrease the tonnage of the furnace, decrease the percentage of ingot production, and badly scorify the furnace banks and the ladle linings. Experience at the Bethlehem plant seems to controvert all of these contentions. Since August, 1920, No. 3 furnace (50-ton capacity) was able to tap 70 tons of alloy ingots at an average time of ten hours and fifteen minutes, the shortest on record. During this time the slags were notably easy to work. Ingot yields were found to be very good if no run-off slag was used. Iron oxide in the slag will average around 9 per cent with high-manganese pig and from 15 to 20 per cent with low-manganese pig. Several months' experience with this furnace shows that scorification is not severe. A bottom delay of eleven minutes per heat was recorded. As for ladle linings it was possible to get eighteen heats per ladle, using one of ninety tons capacity and teeming through a 1½-in. nozzle.

In discussing the action of sulphur on finished steel Mr. Wheaton pointed out that all metallurgists agree that both sulphur and oxygen give much trouble in subsequent working, and then proceeded to argue that residual manganese reduces both of these harmful elements. A steel bath has a tendency to absorb sulphur from a furnace atmosphere in the following manner: Sulphur in the fuel is distilled as such in the gas-producer or burns to oxide. At any rate, the gas when burning in the furnace produces a considerable quantity of SO_2, a little of which may be further oxidized to SO_3. The latter gas coming in contact with the slag forms calcium sulphate with the free lime, and this salt later comes in immediate contact with hot iron, is reduced by the metal, and iron sulphide eventually absorbed. The reaction is

$$CaSO_4 + 4Fe = FeS + CaO + 3FeO$$

Manganese sulphide appears to be soluble both in the slag and the metal and manganese in the bath acts as a continual carrier of sulphur from metal to the atmosphere. Table II shows results from about 200 heats, and on the whole shows that final sulphur in the metal decreases as the residual manganese increases, and also that the elimination of sulphur in the practice under consideration varies directly with the amount of manganese in the charge and the residual manganese in the metal.

TABLE II. RELATION OF RESIDUAL MANGANESE AND SULPHUR

No. of Heats	Mn in Charge	Residual Manganese	S in Charge	Final S
40	0.75 to 1.00	0.15	0.052	0.046
40	1 to 1.5	0.22	0.053	0.043
40	1.5 to 2	0.26	0.055	0.041
40	2 to 2.5	0.38	0.061	0.038
15*	0.66	0.17	0.034†	0.038
15	2.35	0.28	0.039†	0.029

* Nickel-bearing scrap used.
† In pig only.

Unfortunately we have no method of analyzing steel for oxygen, but it is generally considered that under certain circumstances iron takes up so much oxygen that the combined action of such deoxidizers as carbon, phosphorus and silicon cannot eliminate it all.

Red-shortness probably results when oxygen combined with iron is as low as 0.01, while five times as much makes metal unusable. Red-shortness is apparently reduced by manganese; the iron oxide is perhaps not removed, but its bad effects are certainly neutralized. A residual manganese of 0.40 has been found very effective in this respect. Table III shows metal and

TABLE III. METAL AND SLAG ANALYSES FOR TYPICAL HEAT

Tests	Slag Analysis FeO	Slag Analysis MnO	Mn in Metal
1:00 p.m.	19.95	10.06	0.26
1:30	11.09	12.64	0.22
2:00	9.46	9.68	0.32
2:30 tap	9.20	9.93	0.32

slag analyses for one of Mr. Wheaton's typical heats. He holds it to be almost self-evident that a heat which for more than two hours contained an increasing quantity of manganese in the metal certainly cannot be suffering from an overdose of oxygen.

Observations of ingot from this furnace during their passage through the rolling mills showed much less tearing while blooming, and the billets required one-third less chipping for surface defects. Total yield equaled 103 per cent of comparative low-manganese rollings.

Corrosion Resistance of Copper Steel

D. M. Buck presented "A Review of the Development of Copper Steel," in which he cited a long list of investigations, made since 1900 both in the laboratory and under service conditions, showing that normal open-hearth steel is corroded at a much higher rate than when it contains 0.15 to 0.30 per cent pure copper.

Storey[1] investigated a large number of samples of fence wire which had been in actual service for varying lengths of time, comparing the analytical results with the history and length of life of the wires, and from this very carefully conducted piece of work states: "It has been definitely established that the durability of old steel fence wire is due to the presence of copper. Hoyt[2] in 1919, from an extensive series of careful experiments states: "The general conclusion which, it is believed, may be drawn from this exposure test is that the so-called copper-bearing steel, in which the copper content is about 0.20 to 0.25 per cent, offers the greatest resistance to corrosion of the common sheeting materials." The *Railway Age* for July 23, 1920, describes a series of tests conducted by the New York Central Lines on the influence of copper in the reduction of corrosion of steel tie plates. Standard steel tie plates showed approximately eight to ten times the loss as for the special copper treated ones. As a result of these experiments the New York Central has placed an order for 650,000 tie plates, or 4,000 tons, to be rolled according to the railway's standard specifications, with the addition of 0.25 per cent of copper.

The author also makes brief allusion to the results of tests by the American Society for Testing Materials.[3]

"At the inland industrial location, out of 146 sheets of 22-gage copper-bearing materials (0.15 per cent copper or over), forty-one sheets, or about 28 per cent, had failed after forty-one months exposure, while out of eighty-four non-copper-bearing sheets eighty-one, or 97 per cent, had failed after forty-one months exposure.

"With this overwhelming mass of evidence, we may consider it as proved that by alloying a small copper content (0.15 to 0.25 per cent) with normal open-hearth or bessemer steel the corrosion rate is enormously reduced wherever the products are exposed to alternate attack of air and moisture, which conditions prevail in practically all characters of atmosphere. It is certainly very conservative to estimate that the life of sheet metal is doubled by this treatment.

"The manufacture of copper steel has heretofore been largely confined to sheet metal, and the product has been tremendously improved. The usefulness of this discovery may readily be broadened by the use of copper in other steel and iron sections, and their life thereby greatly increased. To mention a single example, steel freight cars, especially those of the open type, suffer greatly from corrosion. If the life of the thousands of such cars that have passed out of the field of usefulness during the past few years could have been increased only 20 to 25 per cent, the result would have gone far toward relieving the severe car shortage which has recently existed." Several hopper-bottom and gondola cars were made six years ago for the Bessemer & Lake Erie Ry., one-half the sheathing of each being ordinary plates and the other half of copper-bearing steel. Recent inspection shows much better paint adherence, and less than half the loss due to corrosion and abrasion.

"We have a simple, easily controlled, and comparatively inexpensive method of improving all of our products that are called upon to resist the attack of air and moisture, thus greatly increasing their period of service and at the same time effecting an immeasurably important step in the conservation of our natural resources."

Alloy Steels for Automobiles

Discussion of the proper heat treatment for automobile steels was presented by R. R. Abbott of the Peerless Motor Car Co., Cleveland, Ohio. In view of the fact that a great deal of research on many different lines had failed to produce an alloy steel markedly superior to any of those which have been known and manufactured for several years past, it appears that the art of manufacturing alloy steels for high strength is quite well established. On the other hand, not nearly so much is known about the correct methods of heat treatment.

Eventually, it will be possible to calculate critical temperatures, merely by knowing the chemical composition. At the present time a few laboratories do this for some of the steels which they control in great quantity and which do not vary much in percentage of the principal alloying elements.

Mr. Abbott was under the impression that no one alloy was superior to all the others now on the market. Consequently, he was of the opinion that personal preference of the user was largely responsible for his choice. Personal preference, of course, is based upon certain facts, and in this case they may be grouped together in two classes: First, the user may have been purchasing a certain brand or analysis of steel for many years and have found it to give him consistently good results, consequently he will swear by that particular alloy. Second, not all heat-treating departments are as well equipped with scientific information as they should be, and consequently they do not vary the heat treatments corresponding to different steels. Consequently one steel matches best the common heat treatments and that particular steel is the one which they like.

Future progress may be looked for by refinements in heat treating even more than in the introduction of new alloy combinations. To support this statement the author has cited the tremendous amount of research work which went on during the war to produce light armor plates of better quality than that specified during pre-war times. After doing a large amount of work on extremely complex alloys, just at the end of the war it was discovered that a very simple and old-fashioned 3½ per cent nickel steel after a suitable but simple heat treatment was far better than anything which had been produced up to that time.

[1] O. W. Storey, "The Corrosion of Fence Wire." *Proceedings* Am. Electrochem. Soc., 1917.
[2] S. M. Hoyt, "Exposure Tests of Sheeting Materials." Chem. & Met. Eng., Aug. 1, 1919.
[3] Chem. & Met. Eng., vol. 22, p. 1189, June 30, 1920.

An Improved Greaves-Etchells Electric Furnace Installation

A Description of the Greaves-Etchells Electric Furnace and of the Arrangement of the Electrical Equipment as Installed at the Plant of the Halcomb Steel Co. —Records of Operation

By EDWARD T. MOORE

DURING September, 1918, the Halcomb Steel Co. placed in operation two 3-ton Greaves-Etchells electric furnaces, constructed and supplied by the Electric Furnace Construction Co., of Philadelphia, which were the first 3-ton furnaces of this type to be started up in this country.

These furnaces are used exclusively for the manufacture of alloy and high-speed steels, and therefore much attention was given to details of design, as operating conditions are much more severe in the refining of high-grade steels. In passing, it might be remarked that this company was the pioneer in the manufacture of electric furnace steels, having installed the first electric furnace in this country in 1906, this original furnace being still in daily operation.

Some years ago H. A. Greaves in collaboration with Harry Etchells realized that in the first place independent regulation of the electrodes was desirable. Secondly, that whenever a short circuit occurred on one arc of an electrode, the surge should be distributed if possible over all the primary supply phases. Thirdly, means should be taken to check short circuits and surges without impairing the permanent power factor of the furnace by introducing extra reactance.

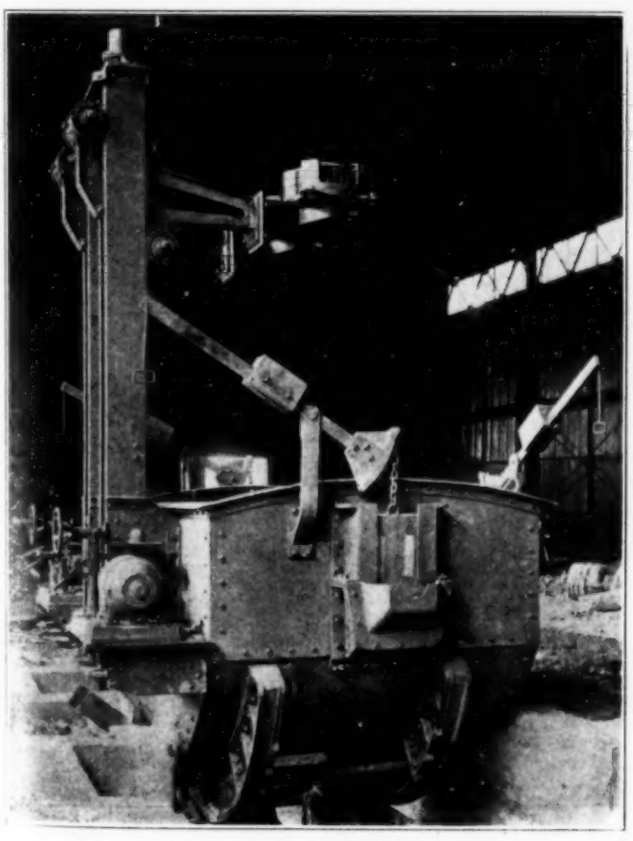


FIG. 1. A GREAVES-ETCHELLS ELECTRIC FURNACE

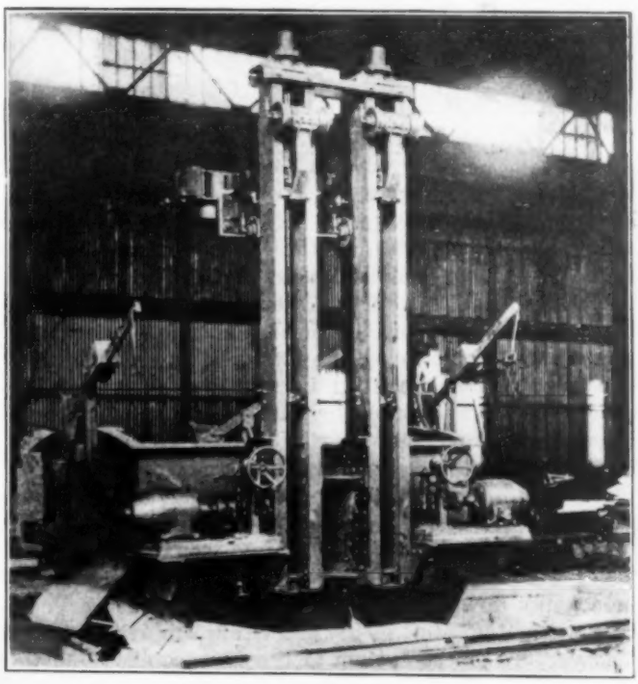


FIG. 2. ARRANGEMENT FOR HANDLING THE ELECTRODE HOLDERS

To fulfill the first two conditions they decided that the furnace must have a conductive hearth, but to assist in fulfilling the third requirement they decided that this hearth should have a certain degree of electrical resistance and should thus act as a resistance check on short circuits. If they could have made the ohmic value of this hearth resistance equal to that of one arc gap, all would be simple and they could have used a three-phase system with two phases applied through separate suspended upper electrodes and one phase applied to the hearth of the furnace. Such a scheme was impracticable for many reasons, but they succeeded in elaborating something which at first sight appears very similar.

In effect three transformer windings are used, the three primary windings being connected in "delta" to the three phases of primary supply.

The secondary windings are connected in "star," two legs being connected to the two upper electrodes and the third leg to the hearth. The third leg, however, which is connected to the hearth, maintains a lower voltage than either of the other two—for instance, the lower leg maintains approximately 27 volts, while each of the upper legs of the "star" transforms to 60 volts. We believe this latter voltage has been standardized at 65 volts. For refining voltage the values are 22 and 45.

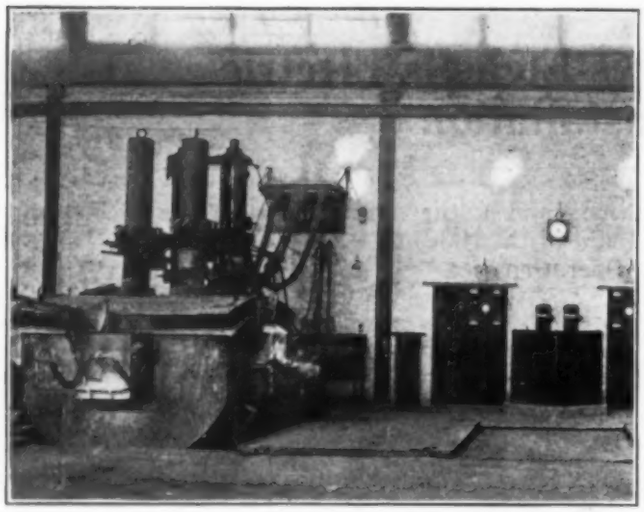


FIG. 3. ARRANGEMENT FOR TILTING

The resistance between the two upper electrodes will be equal to that of two arcs, and the resistance between either upper electrode and the lower electrode will be equal to that of one arc, plus the resistance of the hearth; so that, in order that the system may be balanced, the resistance of the hearth must be equal to that of one arc to bring the total resistance to that of two arcs, and this results in nearly one-third of the energy being distributed by the hearth. Now a basic hearth is a conductor of the second class, and the resistance decreases as a function of the rise in temperature. The resistance of the bottom material near the hearth surface is made very high, but decreases rapidly toward the bottom of the lining, so that the heat generated in the hearth, through its resistance, is principally toward the top, which is in nearer contact with the steel. In proof of this theory, the temperature of the bottom of the furnace shell and the copper electrode in contact with it is such that the hand may be held comfortably in contact with them. This bottom source of heat undoubtedly assists in the circulation of the bath and accounts for the rapid deoxidation of the metal. This circulation has a still more important function in making alloy steels where rapid assimilation of the alloys and a homogeneous bath are very essential.

Description of the Greaves-Etchells Furnace

In general, the furnace is composed of a rugged rectangular boiler plate shell of ¾ in. thickness mounted upon rockers which roll upon a toothed guide bolted to the concrete foundation (Fig. 1). Rising vertically from the furnace shell, and securely riveted at their lower ends to the shell, are four 10-in. channels. The tops of these channels are tied together with two 3-in. angle irons (Fig. 2). These channels serve as a support for two electrode holders and for two worm shafts which are used to raise and lower the electrode holders (Fig. 1). Two 2½-hp., d.c. motors, totally inclosed, furnish the motive power for raising and lowering the electrodes.

The method of tilting, Figs. 1 and 2, is by the balanced rocker type first adopted by the Electric Furnace Construction Co. for this installation, with the object of requiring a minimum effort to tilt the furnace, while the furnace remain safe in any position, accomplished by having the center of radius of the rockers always above but very close to the center of gravity of the furnace in any position, thereby avoiding the excessive effort and heavy structure of the fulcrum type. A 5-hp., three-phase, twenty-five-cycle, 220-volt, slip ring motor situated in a pit remote from the furnace through suitable gearing and a long bronze nut operates an Acme threaded screw, which being fastened to one end of the furnace tilts it through an angle—for normal operation—of 30 deg. forward for teeming and 15 deg. backward for slagging. The tilting screw lies in an oil bath for ideal lubrication and freedom from dirt. The controller for operating the tilting motor is located on a pulpit (Fig. 3) on the melting floor. Automatic limit switches limit the travel of the furnace in both directions, but should special occasion arise, the forward tilt may be exceeded by raising the limit switch.

The electrode holders (Fig. 1) each have a carriage provided with four flanged wheels which roll on the edge of the upright channels and also four pins which slide thereon.

Electrodes of amorphous carbon 14 in. diameter are held into the holders by a series of twenty-eight copper blocks which extend around the electrode, and outside of these blocks are wrapped two thicknesses of 6 x ¾-in. copper bus with their ends bolted to the main conducting bus. Outside the copper bus is placed a flexible supporting chain so arranged that it can be tightened by a draw bolt, thus pressing the copper bus and blocks, and clamping the electrode into position.

A new type of cooling ring has recently been added to the furnace which cools the gases escaping from the furnace between the roof ring and the electrode. The

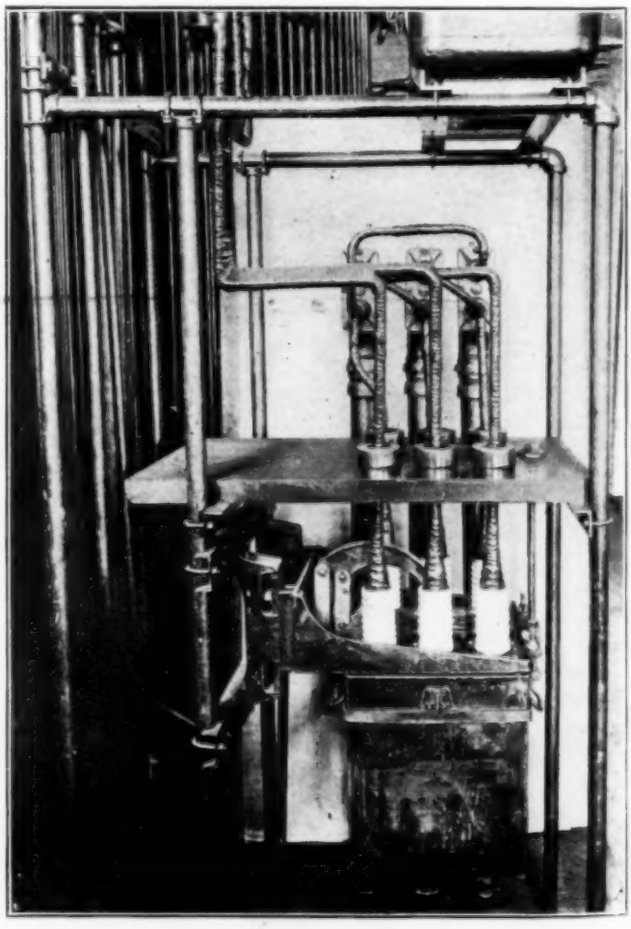


FIG. 4. TRANSFORMER, DELTA CONNECTIONS

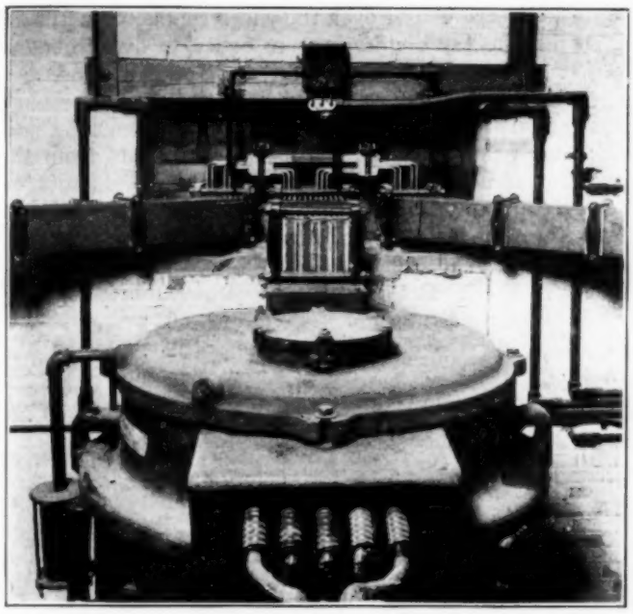


FIG. 5. TRANSFORMER, STAR CONNECTIONS

gases generated in an electric furnace during operation are combustible only at high temperatures and nearly all the present-day cooling rings have for their principal object the cooling of the electrode and the port holes of the roof, which means that if these gases escape to the atmosphere, they are hot enough to burn and in doing so burn up part of the electrode itself, also having a very objectionable effect on the electrode holder.

In this new cooling ring, the roof port holes are kept cool, also the electrode, and still further the gases leaving the furnace are cooled to a temperature at which they will no longer burn when they meet the oxygen of the atmosphere.

The furnace is equipped with separate teeming and slagging spouts.

Linings of the Furnace

As previously mentioned, the hearth lining is especially graded as to resistance and composed of approximately equal quantities of magnesite and "syndolag" mixed with pitch and tamped into a thickness of 22 in. at the bottom. The bottom is burned in by starting a coke fire and gradually bringing up the temperature over a period of thirty-six hours. This method produces a firm bottom, which is necessary when the hearth is used as a resistor. The brick portion of the original bottom of one furnace—that is, the brick lining immediately above the furnace shell—is still in service after having supported 1,047 heats and when the furnace was last relined with the magnesite and "syndolag" an inspection of the brick work revealed a satisfactorily working bottom.

For the very high grade of steels made we insist upon our furnace linings being in perfect condition and for this reason we have made a practice of repairing or renewing the top layers of magnesite-syndolag about once a month, which is approximately after 100 to 115 heats.

The side walls are composed of chrome brick from the hearth to well above the slag line and from this point to the roof with silica brick. The roof is also built of silica brick. In order to permit as near perfect metallurgical conditions as possible the roofs are also changed about every sixty-five heats.

As shown in Fig. 3 the electrical equipment is mounted in a separate building, but adjacent to the furnaces. The primary power used is 11 kv., three-phase, twenty-five-cycle, and is brought to the furnace substation in a No. 0000 B. & S. gage, three-conductor, paper-insulated, lead-incased cable placed in a subway. This cable is terminated in a pothead in the sub-station at a three pole double throw disconnecting switch, and then carried to a 300-amp., Type K-12 oil circuit breaker equipped with inverse time limit overload relays. From the main breaker the three conductor cable is No. 0000 B. & S. gage, varnished cambric, lead-incased and placed in a 3 in. sherardized conduit, the cable terminating at the top stud of two sets of three pole disconnecting switches mounted on the wall, 17 ft. from the floor. From each set of disconnects a No. 00 B. & S. gage, three-conductor, varnished cambric, lead-incased cable in 3 in. sherardized conduit extends to each of the furnace oil circuit breakers, 300-amp., Type K-12, equipped with inverse time limit overload relays and set to trip on 900 kw. load in fifteen seconds. From each furnace breaker a No. 2 B. & S. gage, three-conductor, varnished cambric, lead-incased cable in 3 in. sherardized conduit extends to the transformers. All cables are terminated in potheads.

Each bank of three single phase transformers is composed of two 300 kva. and one 200 kva. transformers, manufactured by the General Electric Co., and they are of the self-cooled circular coil, core type. On account of the resistive bottom serving as a current-carrying medium, which adds additional resistance in one phase, the transformer which is connected to the bottom is of smaller capacity than are those connected to the electrodes. The load in all phases on the primary side is balanced except for a short time when baking in a new bottom.

The transformers are connected in delta on the high tension side and Fig. 4 shows this connection using potheads and solderless connectors. The secondary side is "star" connected (Fig. 5) so that a load on any phase will be borne by two transformers. The units are built for 150 per cent load for one-half hour and 200 per cent load for five minutes.

The 300 kva. units have a secondary voltage of 60 for melting and 45 volts for refining and the 200 kva. units have 27 volts and 22 volts respectively; additional

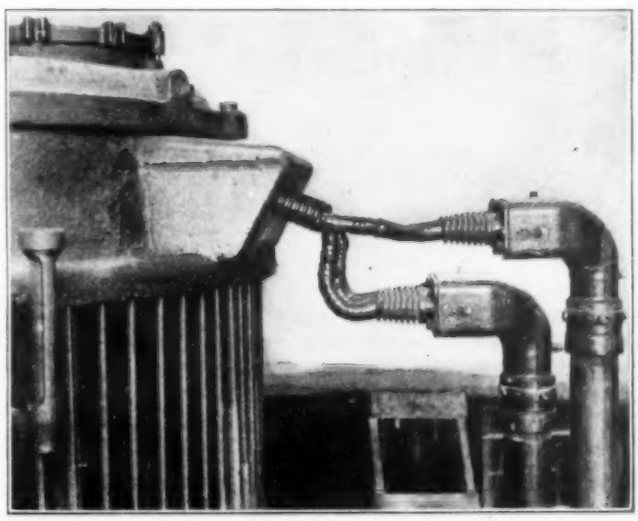


FIG. 6. TRANSFORMER EQUIPPED WITH "SAFETY FIRST" HIGH-TENSION CONDUCTORS

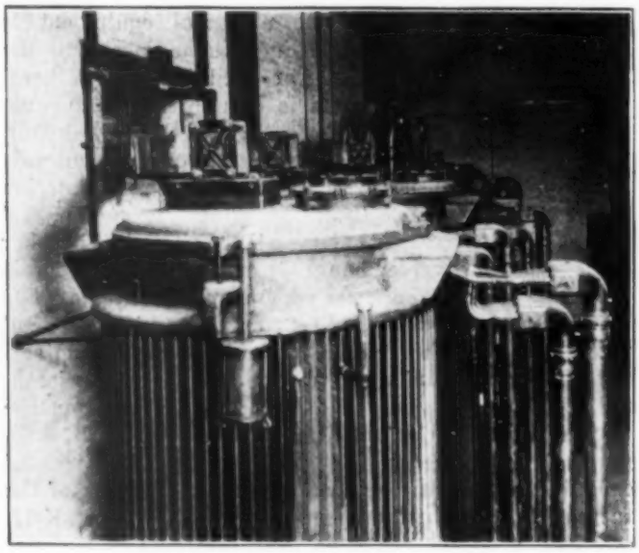


FIG. 7. A BATTERY OF TRANSFORMERS EQUIPPED WITH "SAFETY FIRST" HIGH-TENSION CONDUCTORS

full capacity taps are installed to change the above voltage values as required. This lower voltage increases the useful life of the refractories, especially of the roof, 15 to 20 per cent. The lower voltage during refining gives especially a greater length of life to the roof, since the electrodes shield a shorter arc and protect the brickwork above. Additional taps are provided so that a wide selection of voltages for melting and refining are available.

This change in voltage for melting and refining is accomplished by means of a three-pole, double-throw airbreak switch which is manually operated and interlocked with the furnace oil circuit breaker so that it is impossible to move the tap switch without first opening the oil breaker.

The main high tension conductors to the transformers

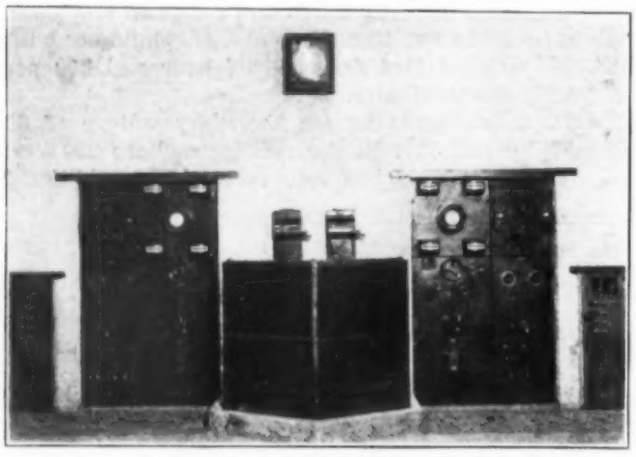


FIG. 8. SWITCHBOARD

are brought to the transformer bushings through No. 2 B. & S. gage, two-conductor, varnished cambric, lead-incased cable in 3 in. sherardized conduit and terminated in two conductor potheads opposite the transformer bushings. (Fig. 6). The tap connections are brought to the transformer bushings through No. 2 B. & S. gage, three-conductor, varnished cambric, lead-incased cable in 3 in. sherardized conduit and terminated in three conductor potheads opposite the transformer bushings. (Fig. 6). The two conductor potheads carrying the main leads are placed over the three conductor potheads carrying the tap connections in order to avoid placing the riser conduits side by side, as by the method used it is possible to remove any transformer from the bank without disturbing the others, which would not be possible were the other method used. The leads from the transformers are connected to the cable conductors by solderless connectors which have proved very satisfactory for this class of construction. The exposed conductors between pothead bushings and transformer bushings are insulated with varnished cambric to withstand five times normal voltage, or 55 kv. By this arrangement of connectors a transformer may be disconnected from the system in a few moments.

All high-tension conductors were manufactured under

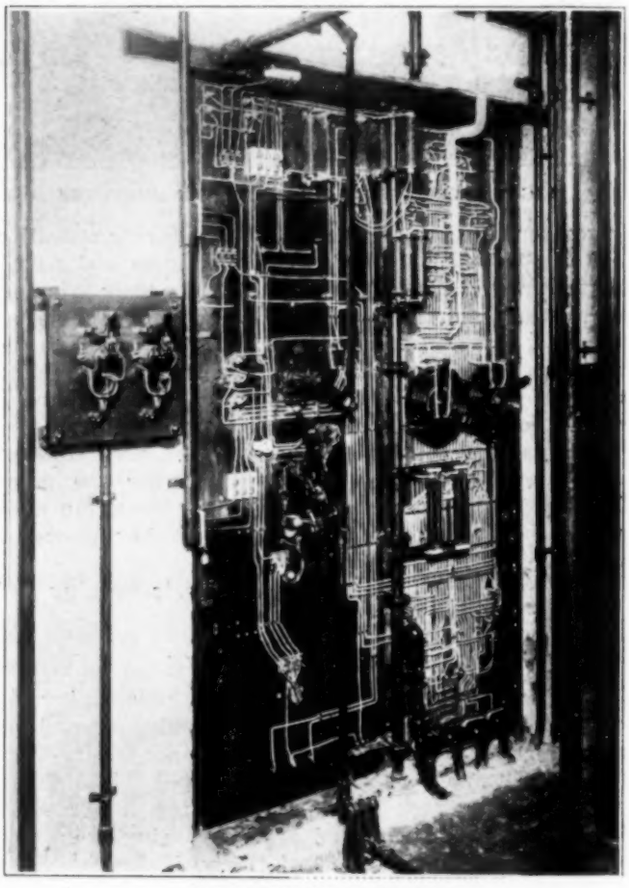


FIG. 9. METER WIRING

specifications made by the Halcomb Steel Co. and are lead incased and all terminate in potheads, the only exposed cable being at points where the conductors pass into the transformer bushings, the oil breaker bushings, the tap switch lugs, and the delta connection. In these instances the conductors are insulated with varnished cambric tape to a thickness to withstand five times normal voltage, or 55 kv., then painted with compound to render them non-absorptive.

This method of construction (Figs. 6 and 7), which may be called a "Safety First" installation, is the only one of its kind, so far as we are aware, in existence, and letters patent are being applied for, covering this method of construction. With the present types of exposed high-tension wiring in use much trouble has been experienced from flash overs on insulators due to dust, and many accidents, some fatal, from men coming into contact with the high-tension equipment while

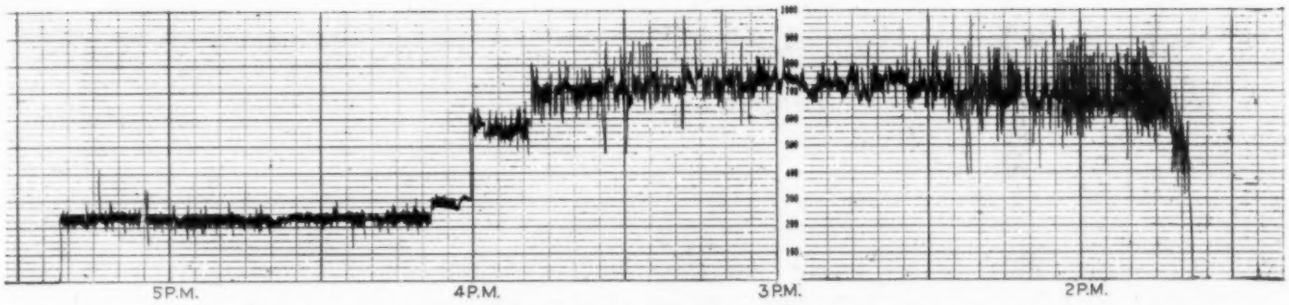


FIG. 10. GRAPHIC RECORD OF KILOWATT VARIATION DURING A HEAT

about their duties. With this improved method it is possible to climb all over the equipment without danger and since its installation it has not cost a single cent for maintenance or repairs. This "Safety First" type of construction will increase the cost of the electrical wiring system about 60 per cent over the regular open wiring method, and for a 3-ton installation this amounted to $2,200 in 1918.

From the secondary coils of the transformers, copper busbars extend in interlaced formation to the wall which separates the transformers from the furnaces. In an opening in this wall the "star" connection is formed (see Fig. 5), and outside the wall on the furnace side the current transformers are mounted, and thereby recording the time a circuit breaker is opened or closed and the duration of time in each position. From the chart on this meter it is a simple matter to count the number of times the breaker is operated, which serves as a guide for determining when to change the oil in the breaker tank. The potential and current transformers on the primary side are mounted on a pipe frame behind the switchboard but a sufficient distance away to prevent any trouble being communicated to the wiring on the back of the switchboard. All meter wiring (Fig. 9) is of fire-proof insulation and is suitably terminated on terminal blocks so that tests can be made without cutting or opening a circuit.

The auxiliary hand control panels for operating the

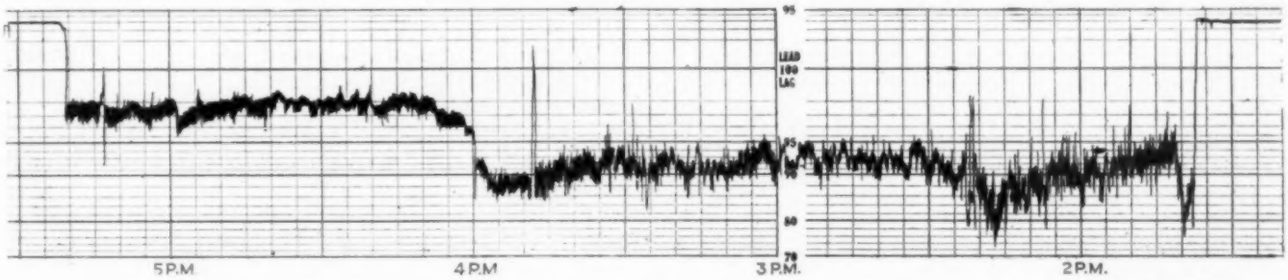


FIG. 11. GRAPHIC RECORD OF POWER FACTOR VARIATION ON THE HIGH-TENSION SIDE OF THE TRANSFORMERS DURING A HEAT

the flexible cables, which loop to the furnace in phase groups, are attached to the ends of the bus just outside the "star" connection. These cables, of which there are twelve for the center phase and eight for the outside phases, are 600,000 circular mils and composed of sixty-one strands—seven wires to the strand and rope laid. The groups of cables forming a phase are supported on wooden grooved drums so as to take away all strain and weight from the cable lugs.

The switchboard (Fig. 8) contains an indicating wattmeter, watthour meter, low tension voltmeter with voltmeter receptacle and plug, two ammeters, inverse time limit overload relay, contactors, contact-making ammeters, oil breaker operating mechanism and tap switch operating wheel. A General Electric automatic regulator controls the position of the electrodes, and consequently the power input of the furnace. A graphic polyphase wattmeter and graphic polyphase power factor meter are installed in the substation. A recording thermometer is also installed having two pen movements—one to record the room temperature, the other to record the oil temperature in the transformers. The oil breaker operating handle is connected to a signal switch which lights a red or green signal lamp to indicate visually the position of the breaker. The signal switch also has a separate contact for connection to a recording meter having pens which move laterally, electrode motors by hand are shown in Fig. 8 at extreme left and right of cut. Current for electrode motors is furnished by a 20-kw., 230-volt, d.c. compound wound motor generator set located in the substation.

Fig. 10 is a reproduction from a polyphase graphic

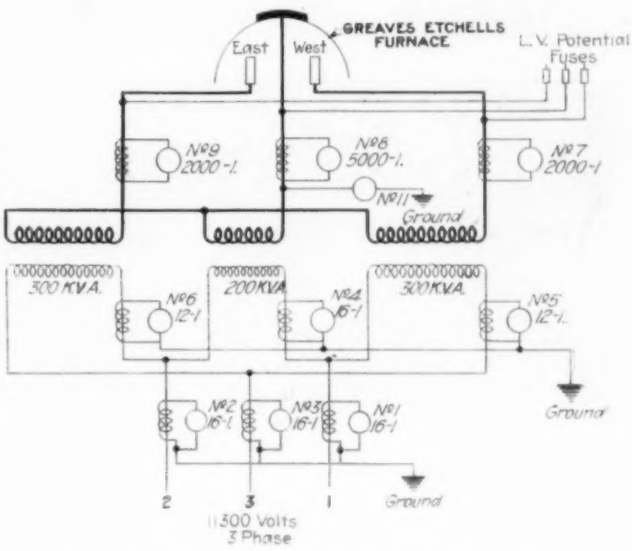
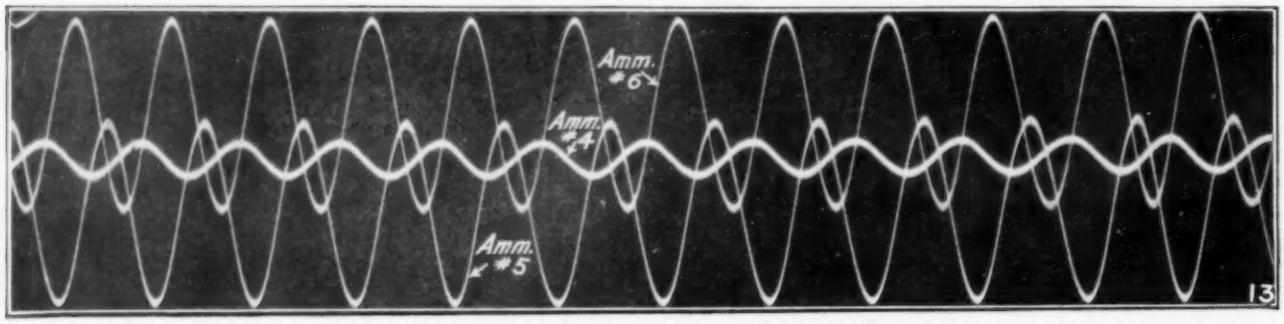
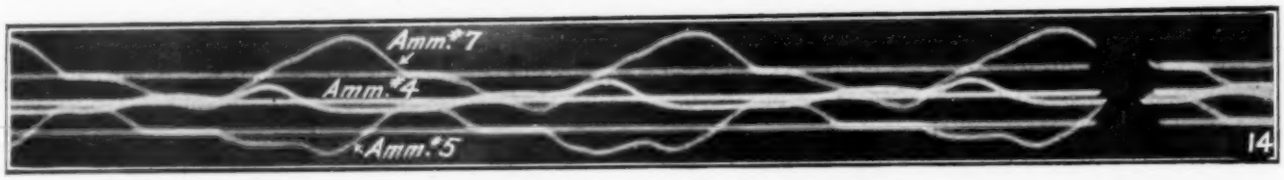
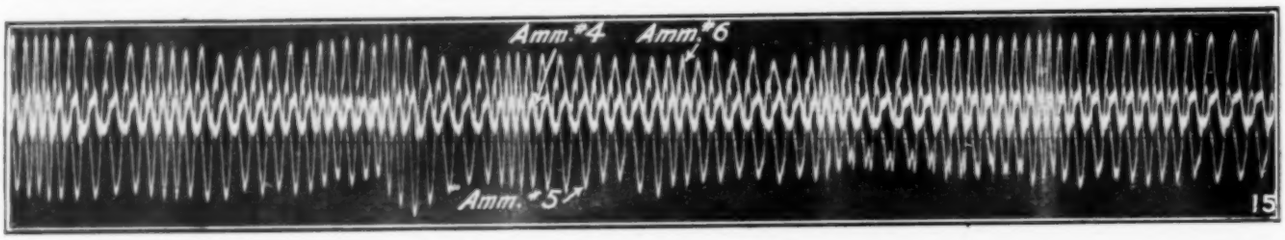
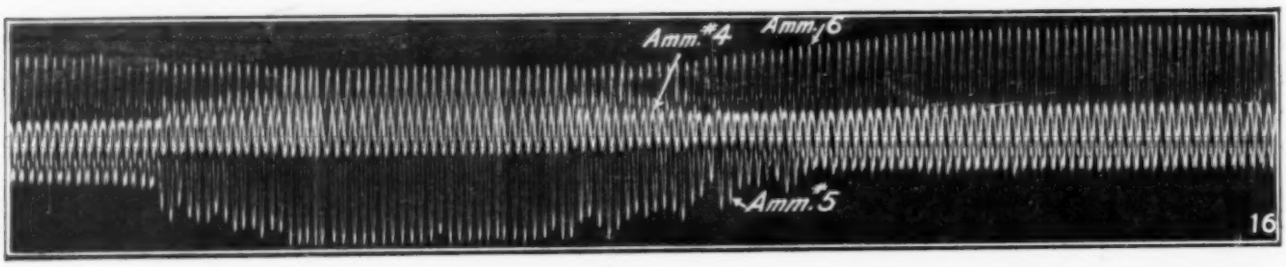


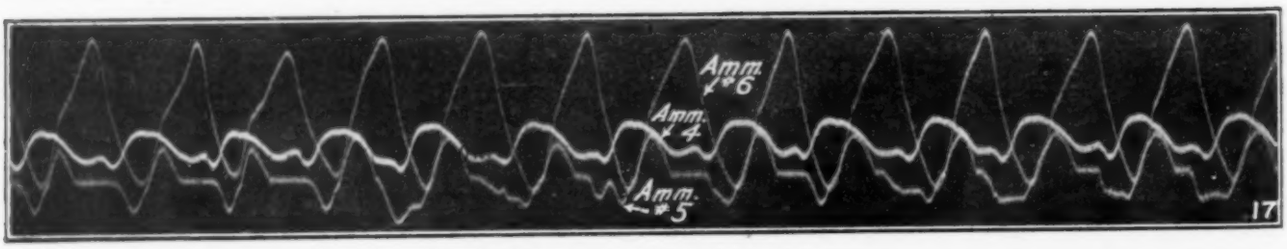
FIG. 12. FURNACE NO. 6 TEST CONNECTIONS

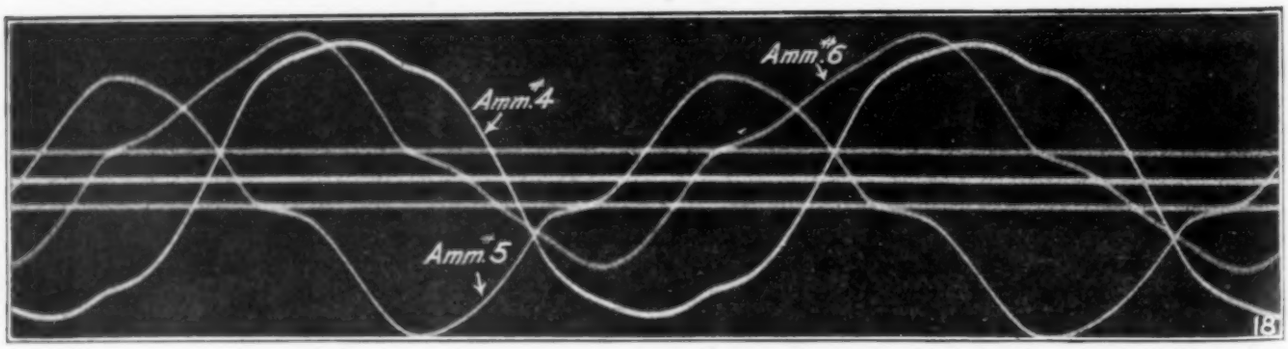












FIGS. 13 TO 18. OSCILLOGRAPH TESTS OF GREAVES-ETCHELLS ELECTRIC FURNACE NO. 6 AT THE HALCOMB STEEL CO. PLANT

Current waves on furnace No. 6: Fig. 13. Hand control, electrodes purposely shorted. Highest current values (effective amperes) attained: Amm. No. 5, 96.8; No. 4, 43.7; No. 6, 87.9. Dec. 31, 1918. Fig. 14. Hand control at start of run. Highest current values: No. 5, 29.5; No. 4, 26.2; No. 7, 35.4. Dec. 31, 1918. Fig. 15. Hand control, 1 to 1½ hr. after start of run. Highest current values: No. 5, 75.4; No. 4, 70.8; No. 6, 54.5. Dec. 31, 1918. Fig. 16. Hand control: 1 to 1½ hr. after start of run. Highest current values: No. 5, 94.6; No. 4, 36.6; No. 6, 60.5. Dec. 10, 1919. Fig. 17. Automatic control. High secondary voltage used during melting. Highest current values: No. 5, 52.3; No. 4, 37.3; No. 6 73.6. Dec. 31, 1918. Fig. 18. Automatic control. Low secondary voltage used during refining. Highest current values: No. 5, 25.3; No. 4, 14.5; No. 6, 16.9.

wattmeter recording the kilowatt variation during one of the heats. The melting period started at 1:38 p.m., and by 2:25 p.m. a considerable pool of molten metal was formed. At 3:48 p.m. the metal was all melted and the voltage was reduced to the low refining voltage with an input of approximately 575 kva. At 4 p.m., the load input was reduced to 300 kva. and at 4:08 p.m. was further reduced to 230 kva., where it remained until the end of the heat at 5:22 p.m., a total length of three hours forty-five minutes. The exceptionally low input required to maintain the heat balance during the refining period is worthy of note, and this low input can be obtained only by using a low voltage relatively during refining. The advantage of the use of a lower voltage for refining than for melting was first discovered and used in this country by the Halcomb Steel Co., and patents were applied for some time ago covering the process and apparatus in connection therewith. Fig. 11 is power factor chart for above heat, and represents the operating power factor on the high-tension side of the transformers.

Electrode consumption over a considerable period was 30.6 lb. per net ton of steel produced, including electrode breakage. Due to "war quality" electrodes, this figure is somewhat higher than during normal times, as a consumption of less than 20 lb. per net ton, including breakage, has been secured over many monthly periods.

The temperature of the transformers during a day's run varied quite gradually from 32 deg. C. at 9:30 a.m. to 50 deg. C. at 7:30 a.m., the ambient or room temperature varying during the same period between 12 and 20 deg. C. The time between heats of the charging period causes a small reduction in temperature. The room temperature was only 4 to 5 deg. higher than the outside air and demonstrates the efficiency of the ventilating system used in the substation.

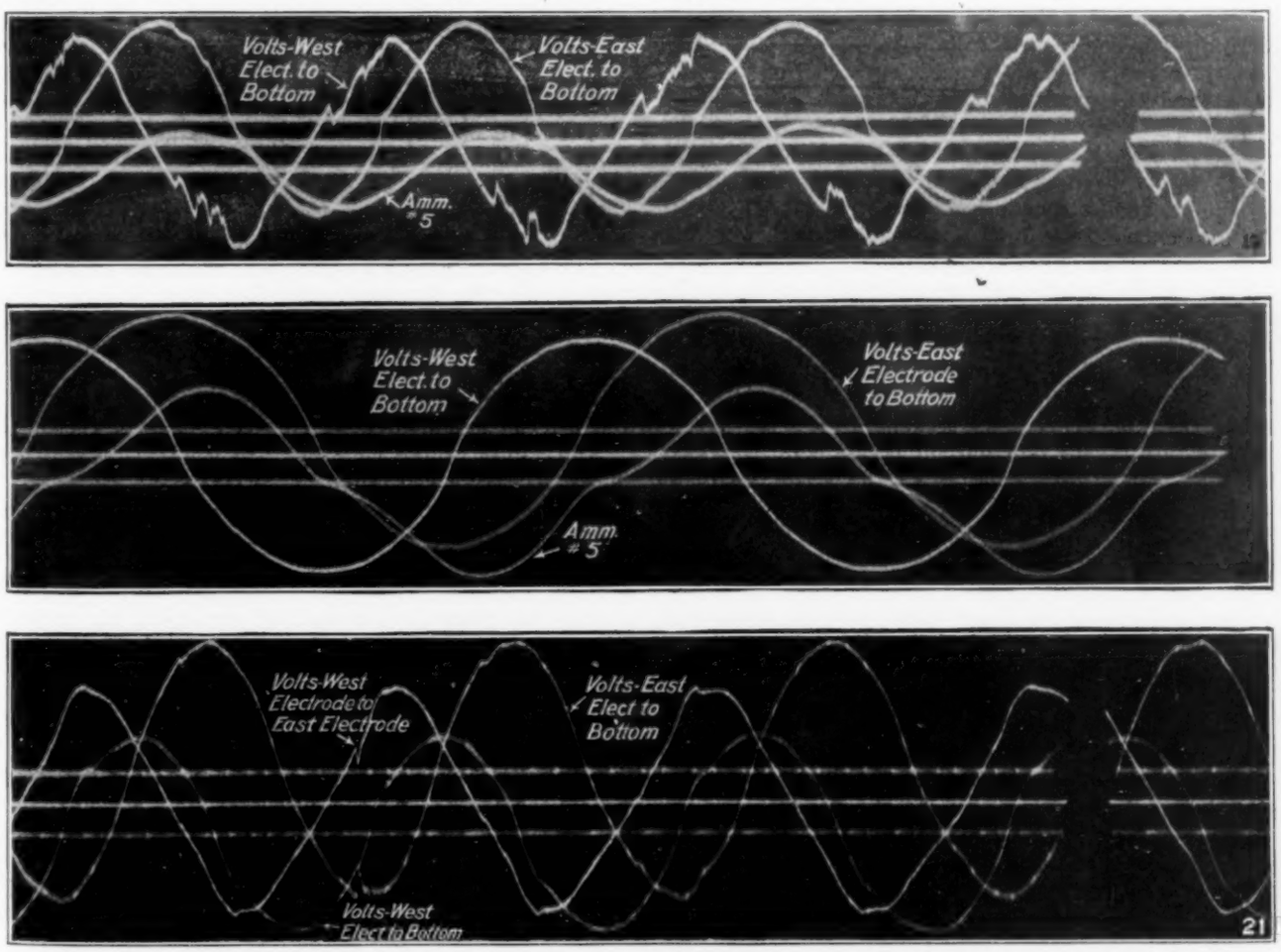
In order to determine the maximum overload currents which could be drawn by the furnace, instruments were connected into the circuit with instrument transformers as per Fig. 12. The numbers used in the following data refer to the corresponding numbers in Fig. 12.

Primary volts, 11,300—11,500.					Secondary volts, 59—61—81.				
Meter.....	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
Starting heat.....	35.2	24.0	51.2	6.4	31.2	22.8	7,000	2,000	7,000
1 hr. after start...	48.0	36.8	27.2	16.0	27.6	25.2	4,600	5,750	4,200
	33.6	33.6	35.2	14.4	23.4	22.8			
	36.8	32.0	37.6	14.4	27.0	22.2			
2 hr. after start...	38.4	40.0	41.6	16.8	27.0	28.2	5,000	6,500	5,000

There were swings as follows:

0 84.0 84.0

This indicates clearly the bottom of the furnace has a very high resistance when cold, although this does not prevent an adequate current flowing for rapidly baking in a new bottom.



FIGS. 19 TO 21. OSCILLOGRAPH TESTS OF GREAVES-ETCHELLS ELECTRIC FURNACE NO. 6 AT THE HALCOMB STEEL CO. PLANT

Fig. 19. Current and secondary voltage waves in furnace No. 6. Hand control. Start of heat. High secondary voltage. Amm. No. 5, 51.4 effective amperes. Voltage on Nos. 2 and 3, 60 volts, read on portable meter. Vib. No. 2, volts west electrode to bottom. Vib. No. 3, volts east electrode to bottom. Dec. 31, 1918. Fig. 20. Current and secondary voltage waves in furnace No. 6. Automatic control-refining. Amm. No. 5, 19.9 effective amperes. Voltage on Nos. 2 and 3, 60 volts, read on portable meter. Vib. No. 2, volts west electrode to bottom. Vib. No. 3, volts east electrode to bottom. Dec. 31, 1918. Fig. 21. Secondary voltage waves in furnace No. 6. Automatic control. 400 kw. in furnace. Vib. No. 1, volts west electrode to bottom. Vib. No. 2, volts west electrode to east electrode. Vib. No. 3, east electrode to bottom. Dec. 31, 1918.

Referring to the oscillograms, the following table indicates the effective values of the maximum currents observed:

Fig	300 kva. 1 main. Eff. Amp.	200 kva. 1 main. Eff. Amp.	300 kva. 1 main. Eff. Amp.	
13	96.8	43.7	87.9	Hand control. Electrodes purposely shorted.
14	29.5	26.2	35.4	Hand control. Start melting period.
15	75.4	70.8	54.5	Hand control. 1 to 1½ hr. after start of heat.
16	94.6	36.6	60.5	Hand control. 1 to 1½ hr. after start of heat.
17	52.3	37.3	73.6	Automatic control. High secondary voltage used during melting.
18	25.3	14.5	16.9	Automatic control. Low secondary voltage used during refining.
	Eff. Amp.	Volts	Volts	
19	51.4	60.0*	60.0*	High control. Start of heat. High secondary voltage.
20	19.9	60.0*	60.0*	Automatic control. Low voltage—refining.
21	Volts west electrode to center	Volts west electrode to east electrode	Volts east electrode to center	Automatic control; 400 kw. in furnace. Low voltage—refining period.

* Voltage on 2 and 3, east electrode to bottom and west electrode to bottom, read on portable meter.

By referring to the oscillograph curves it will be noted that during the melting period the load is constantly changing from zero to three to four times normal. The frequency of these surges is such that a very few seconds may exist between them, although with a properly designed installation they are not severe enough to make this class of load undesirable to the central station—in fact, a furnace load is a very desirable one due to its 24-hr. use. With several furnaces operating on a system the diversity is such that only occasionally are demands excessive. There is also some variation in the severity of the load with different furnace charges. In other words, the position and shape of the scrap metal which is next to the electrodes when starting the heat is such that occasionally the initial melting of the charge is more severe than at other times.

These tests indicate that electric furnace loads are more severe on transformers than are the usual lighting and power loads, first, because breaking the low voltage arc on the cold metal may, with the proper combination of conditions, set up oscillations in the transformers, and second, because subjecting transformers to a severe short-circuit occasionally is a very different matter from subjecting it to hundreds of partial short-circuits per hour. It is for these reasons that furnace transformers should be especially designed to withstand the tremendous mechanical stresses produced.

Figs. 19 and 21 show evidences of high frequency, although not especially high, being between 6,000 and 9,000 cycles.

The current records in Fig. 17 are not symmetrical, which would indicate a partial rectification.

The maximum current values found in the oscillograph tests are not as high as those found in the meter test. This is because it was possible to observe the meter over a longer period of time and thus determine the maximum of many current rushes. The oscillograph measured the maximum current for the particular current rush for which the film was taken, but the one just before or after might have been higher. It would be very desirable if a very long film holder could be devised so that a reasonably long record could be obtained—long enough to cover any reasonable observable period—as under operating conditions it is very difficult to determine just when the looked-for phenomenon is to occur.

The phenomena of high frequency and rectified currents are not peculiar to this type of electric furnace, as similar results have been secured during oscillograph tests made on other makes of furnace—in fact, the electric arc itself is responsible for whatever currrent rectification takes place.

Our experience has been that an electric furnace installation when properly designed and constructed is a desirable load for a central station and with this type of furnace the fluctuations seem to be such that it has proved itself to be an attractive proposition to us as steel makers and also to the central station supplying us with power.

Syracuse, N. Y.

Who Is Your Boss?

You're working day after day in the big shop.

You're getting a certain amount of money for your work.

You're either satisfied and happy or else you're sore about something.

If you're satisfied and know you're getting along all right—fine!

If you're sore, I want to ask you one question.

Do you know who is your boss?

"Sure, Mike," you say, "I'm working for the man who owns this business. He's my boss!"

But that's not so—not on your life!

You're working for yourself.

You betcha are!

Sounds funny, don't it?

It's a fact just as sure as you're a day old!

You're in business for yourself just as much as the big guy who owns the business.

The big guy isn't your boss at all.

He's your customer, and you're selling something to him, just like he's selling something to the people.

The only difference is that he's got a lot of money tied up in the business which he takes a chance on losing.

You've got your money in the savings bank where it's safe.

Now, the "boss," he's selling goods to his customers, the people—because the people need them.

And you're selling your work to your customer, the "boss"—because he needs it.

Now, supposing the "boss" starts in to make poor goods. He don't give the people full value for their money.

What happens?

Why, the people find it out and won't buy his goods. They buy some other guy's goods and he loses his customers.

Now, supposing you start in selling your customer, the "boss," poor work. You don't give him a full day's work for a full day's pay—what then?

Why, the boss is going to do the same thing with your poor work that the people would do with his poor goods.

He's going to buy someone else's work. You lose your customer and have to look for somebody else to sell your work to.

The people have got a right to buy the best goods they can get for their money.

The "boss" has got the right to buy the best work he can get for his money.

You've got to look at it this way before you can get ahead.

—*Arizona Mining Journal*, October, 1920.

Precautions in the Use of Dimethylsulphate

By Max Mueller, Ph.D.

ALTHOUGH dimethylsulphate is known to be the most convenient methylating agent and is used in large quantities in Europe in both the dyestuff and the synthetic perfume industries, it has not yet met in this country with the attention it deserves. This is due principally to the widespread opinion that it is an extremely dangerous poison. Text books have exaggerated its poisonous effects when many things more dangerous —things in common use—are not so mentioned. The danger with it is not greater than, for example, with aniline, provided the proper precautions are taken.

The reasons why dimethylsulphate should be preferred to other methylating agents are first, because it acts at low temperatures; second, the methylation can be conducted at atmospheric pressure. The following reactions show the mechanics of the methylation of phenols:

$$R\text{-}OH + SO_4(CH_3)_2 + NaOH = R\text{-}OCH_3 + SO_4CH_3Na + H_2O \quad (1)$$

$$R\text{-}OH + SO_4CH_3Na + NaOH = R\text{-}OCH_3 + Na_2SO_4 + H_2O \quad (2)$$

Reaction (1) is complete at ordinary temperature; reaction (2) generally requires 100 deg. C.

The reaction with amines is more complicated since, as is the case with all methylating agents, all the possible methylated products may be formed.

$R\text{-}NH_2$ may give $R\text{-}NHCH_3$,

$$R\text{-}N(CH_3)_2, \text{ and } R\text{-}N \begin{matrix} -CH_3 \\ -SO_4CH_3 \end{matrix}$$

By choosing the right conditions, however, the desired compound can be obtained in good yield.[1] As a rule the methylation is carried out by adding simultaneously dimethysulphate and alkali to an aqueous solution or suspension of the phenol or the amine. Sometimes the results are better when dimethylsulphate is added first and then the alkali. The temperature varies from 0 to 30 deg. C. Also benzine, ether or dimethylsulphate itself are used as diluents in some cases.

Commercial dimethylsulphate is almost chemically pure. It is a colorless or faintly yellow liquid of sp.gr. 1.334 at 15 deg. C. It boils at 188 deg. C. It has rather a pleasant etherial odor. It does not contain free acid and does not attack metals, and so may be kept in iron drums or containers.

Some danger thus lies in the harmless appearance of this compound. Moreover, the danger is increased by the fact that it has a considerable vapor pressure in spite of its high boiling point, and that its action on the skin and mucous membrane is not immediate. The vapors attack the delicate membrane of the eyes and respiratory organs, while the liquid is readily absorbed by the skin and then acts internally. Its poisonous action is a combination of the actions of its decomposition products when it reacts with water.

$$SO_4(CH_3)_2 + H_2O = SO_4HCH_3 + CH_3OH$$

The action of the methylsulphuric acid is local. It blisters the skin and forms sores which take a long time to heal. The action of the methanol is general, affecting the central nervous system and in some serious cases a weakening of the optic nerve was observed.

As pointed out by Weber[2] some men died by its action in the early days of its use, but during the last ten years no fatal accidents have been recorded. During the writer's twenty years experience in handling dimethylsulphate only very few serious cases occurred and these during the earlier years. Most of these were due to the carelessness of the workmen.

Its action thus being known, the following precautions should be observed:

All containers of dimethylsulphate should be kept out of doors, but in a dry, cool place. Small bottles for laboratory use should be kept in a separate room with other dangerous chemicals. Storage tanks for the plant should be installed in sheds outside the methylation building. The reaction tank should have a tight cover and a ventilating pipe leading through the roof, equipped with a steam injector so that a slight vacuum is formed in the pipe and any dimethylsulphate vapor escaping is destroyed. All transferring of dimethylsulphate from one tank to another should be done by vacuum.

It is not as easy to destroy dimethylsulphate as one would think from its reaction energy. It is slightly soluble in water and is not instantly decomposed even in presence of an excess of alkali. The decomposition is rapid only at about 80 deg. C., but proceeds then with such a production of heat and so quickly that if any considerable amount of dimethylsulphate is present, vapor produced will project the whole contents of the tank through the openings. So if apparatus containing dimethylsulphate has to be cleaned, the greatest amount of it has to be removed. What remains is destroyed by adding enough diluted caustic soda for neutralization and passing a current of steam through the whole apparatus until its temperature is higher than 80 deg. C.

Any amount of dimethylsulphate dropped on the floor should be covered immediately with dry soda ash or caustic lime and then washed away with water after a few minutes. If working in an atmosphere of dimethylsulphate is necessary, a tight army gas mask should be worn. It proves to be efficient for fifteen minutes at least.

The treatment of men gased by dimethylsulphate depends on the gravity of the case. If the eyes are attacked, they should be washed two or three times with carron oil. This treatment is somewhat painful, but if done in time prevents all serious trouble and generally allows the man to go back to work the following day.

In more serious cases dimethylsulphate vapors may get into the respiratory organs, provoking an inflammation of the larynx and bronchial tubes. In this case it is best to send the man to the hospital or at least to keep him under close observation, as sometimes breathing may become difficult for a few hours and the administration of oxygen may become necessary.

Clothes impregnated with dimethylsulphate must be removed immediately and washed with boiling water and soda ash.

With the ordinary precautions of cleanliness and care that should be exercised with any organic chemical, no serious consequences will ever result and the writer wishes to impress upon the profession to set aside the previous exaggerated conception of the danger of this product.

[1] See Ullmann, Encyclopædie der techn. Chemie, vol. 1, pp. 262-263; Weyl, vol. 2, p. 604; Decker and Koch, *Ber.* vol. 40, p. 4794 (1907); Werner, *J. Chem. Soc.* vol. 105, p. 2762 (1914); Shepard, *Am. Chem. Soc.*, vol. 38, p. 2,507 (1916).

[2] Weber, *Chem. Centr.* vol. 1, p. 361 (1902).

Legal Notes

By Wellington Gustin

Widow May Not Recover Where Employee Assumed Risk of His Employment

In an action under the common law for damages for death of an employee the Court of Appeals of Georgia has dismissed the case brought against the Donalsonville Oil Mill by the decedent's widow. It was alleged that the negligence of the defendant corporation consisted in not furnishing the deceased a safe place in which to work. It was shown that complainant's husband had at least equal means with the Oil Mill company of knowing that the place in which he worked was unsafe and that he voluntarily continued, and without objection, in the employer's service. Therefore, said the Court of Appeals, it was not error to dismiss complainant's petition, it showing there is no right of action accruing, and judgment was affirmed.

Meaning of c.i.f. as Distinguished From f.o.b.—Rules Governing Such Contracts of Shipment

Some interesting propositions of law arise in the case of Fred O. Seaver against the Lindsay Light Co. decided for the plaintiff by the Supreme Court for Kings County, New York.

A broker in London asked the defendant in Chicago if it had thorium for sale. The broker was referred to defendant's brokers in London, who would quote prices. After various correspondence between the two brokers, defendant's broker submitted an offer from the defendant. This was accepted in a cable sent the defendant at Chicago, and the defendant's confirmation of this acceptance was contained in a cablegram sent to its London agents and transmitted by them to the first broker. The acceptance of the final offer showed that the goods were being purchased for a corporation in Holland. The thorium was to be delivered in six monthly installments at the price of $4 a lb. cash in advance, c.i.f. Rotterdam. Later, by mutual consent, the contract was changed to c.i.f. London dock. A portion of the monthly deliveries was never shipped, and this action was brought to recover the damages sustained by the buyer, the plaintiff being its assignee.

Place of Delivery the Important Factor

The buyer claimed the contract was made in London, the seller claimed it was made in Chicago. The court thought the latter contention correct, but held this was immaterial, for in an action between buyer and seller for damages for non-performance of a contract of sale the place of delivery is the important factor. The damages are measured by the value of the goods at the place of delivery, and not at the place where the contract was made.

The question as to what was the place for delivery under this contract is to be determined according to the intention of the parties.

Ordinarily, in the absence of special facts, a contract to sell goods is completed when the seller delivers them to a carrier to be transported to the buyer. That constitutes a delivery to the buyer, and this is true although the goods are not then paid for.

But this rule does not apply, said the court, if the seller agrees to deliver the goods at the buyer's place, or makes some other agreement showing a different intention of the parties. So, under the common provision f.o.b. place of shipment, the seller's obligation is completed when he ships the goods, and title to them passes then, and he is not obliged to pay the freight. But if the agreement is f.o.b. place of destination, the seller must pay the freight, and may be deemed to have retained the title to the goods until their arrival at the point of destination. But where the intention of the parties is different that will control. Hence the fact that the freight was paid by the seller is not conclusive that the delivery was to be at the place of destination.

Meaning of the Term c.i.f.

The provision c.i.f. seems rarely to have been used in commercial contracts in this country, and many textbooks contain no mention of the term. It is defined in II Corpus Juris, p. 765, as an expression indicating that the price fixed covers the cost of the goods and insurance and freight on them to the place of destination. Under a contract containing such a provision, the seller must ship the goods, arrange the contract of affreightment to place of destination, and pay its cost or allow it from the purchase price, and procure insurance for the buyer's benefit for the safe arrival of the goods and pay therefor. When the seller has done this and forwarded the papers to the buyer, he has fulfilled his contract, and delivery is complete. There is no obligation by the seller to deliver the goods at the place of destination.

The above principle was stated and approved by the Supreme Court of the United States in Thames & Mersey Insurance Co. vs. United States, 35 Sup. Ct., 496. This is the meaning and effect of the letters c.i.f., in the absence of any agreement to the contrary or any provisions showing a different intention. The court was convinced no different intention was shown in the cause on trial, and this was emphasized by the requirement that the seller must procure insurance for the buyer's benefit. This indicates, said the court, that delivery was to be complete at the place of shipment and that the title to the goods was in the buyer from that time. Hence the buyer required the seller to secure insurance for him. If the goods were still the seller's until they reached their destination, the risk of their safe arrival would be the seller's and the buyer would have no concern about that. He would lose nothing if the goods did not arrive; the loss would fall upon the seller. This and similar provisions in contracts have been held to be controlling factors in determining the intention of the parties.

If it had been the intention of the parties that delivery should not be complete until the goods arrived at London, an "f.o.b. London" provision could have been inserted in the contract. The difference between an "f.o.b. London" contract and a "c.i.f. London" contract has been pointed out.

So there is nothing here to show the parties had in contemplation that the value of thorium in London should be the measure of damages. The buyer proved the value of thorium in London, but offered no proof as to its value in Chicago. The seller's proof of the Chicago value plus freight and insurance charges was therefore undisputed, and must be accepted as the basis upon which the buyer's damages must be calculated. The same rule of damages applies where there is no shipment made as where a shipment is made that does not conform to the contract.

Industrial Excursions of the Chicago Meeting of the American Chemical Society

Notes on and Views of the Doehler, Sherwin-Williams, Pullman, Fleischmann, Steel and Tube, Northwestern Terra Cotta, Fansteel, Sears-Roebuck and Heath & Milligan Plants

WEDNESDAY afternoon and all day Friday, Sept. 8 and 10, of the program of the Chicago meeting of the American Chemical Society were given over to industrial excursions. The following notes and views are offered both by way of report of the meeting and as a record for future reference of the important plants operating in this district.

Doehler Die Casting Co.

While this plant is a small one as compared to some of those visited, it is nevertheless important from the point of view of uses of alloys in the construction of machine parts. These alloys are made up with a zinc base, a tin base, a lead base, an aluminum base and a copper base. They are melted in the foundry, a corner of which is shown in Fig. 1, and cast in ingots for subsequent use in the die-casting machine. It is not economical to make a die casting where less than 5,000 pieces are required, as the dies are extremely expensive to make.

At the Chicago plant gas is used for fuel and requires from 1½ to 4 cu.ft. per lb. of metal produced, the higher figure being required in the making of an aluminum alloy. A large quantity of compressed air is used in the operation of the die-casting machines and is supplied from one Ingersoll-Rand and two Sturtevant air compressors at a pressure of about 200 lb. per sq.in. The casting operations are extremely interesting from a mechanical point of view. As the pieces come from the machine they are cleaned, hand filed and often trimmed in dies.

Tin-base alloys are not attacked by organic acids and can therefore be used for food containers. They are slowly corroded by mineral acids and alkalis but are comparatively unaffected by water, neutral aqueous solutions, and damp or warm climatic conditions.

Lead-base alloys are insoluble in dilute sulphuric acids and are consequently well adapted for fire extinguishers, etc. They are soluble in nitric acid, but very slowly soluble in hydrochloric acid. Contact with organic acids form the base of lead salts which are poisonous.

Aluminum-base alloys are readily soluble in alkali solutions, but insoluble in nitric acid. They are also readily soluble in dilute hydrochloric and sulphuric acids, and soluble with difficulty in these acids when concentrated.

Sherwin-Williams Co.

This plant is one of the largest manufacturers of insecticides, paint and varnish and the raw materials for these products in the world. It also manufactures lithopone pigments, tin cans, dyes, dry colors, wood preservatives, tar products, and makes the largest amount of acetic acid for its own consumption of any plant in the world. The old Dutch process white lead plant, which was visited by the members of the society, will be described in a subsequent issue.

The company is just erecting a new quick-process white lead plant which will increase the capacity for white lead production 15,000 tons per year. This new plant under construction is shown in Fig. 2. At the same time the company is erecting a plant for the manufacture of red lead and litharge.

The Pullman Co.

From the point of view of large-scale manufacturers the Pullman Co. was one of the more interesting plants visited. The underframe of the Pullman car is first erected on temporary trucks, the end frames are then set on and the next shop puts on the sides and roof. When all the heavy steel work is erected the permanent trucks are substituted for the temporary trucks and the car goes to the yards for a sand blasting. A priming coat is put on over the outside and finally the finishing coat.

The first work done on the interior is the construction of a "chanarc" steel floor over which a cement floor is laid. This cement consists of magnesium oxychloride. The interior finish of the car requires the work of many craftsmen, including woodworkers, electricians, plumbers, interior decorators, etc. The completed car costs between $20,000 and $50,000.

The shops cover space ½ mile wide and 1½ miles long and employ 9,000 to 13,000 men in the operation. The capacity of the plant is two Pullman cars and four coaches per day. These coaches, together with the freight cars, are made in a separate shop.

The company is just putting into operation a new freight-car shop which will produce a completed freight car every fifteen minutes, the assembly being carried on after the manner in which Ford automobiles are assembled.

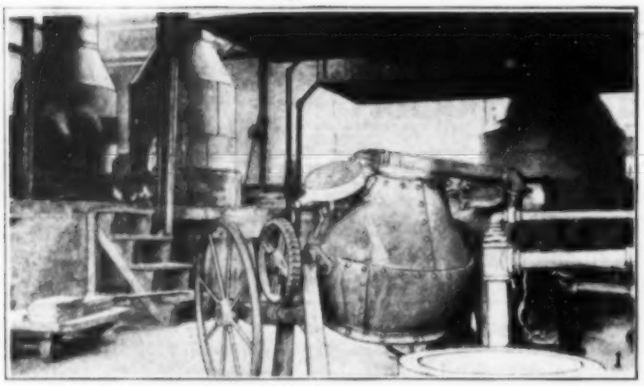
The work in the chemical laboratory consists mainly in supplementing the work of the Committee of Standards and analyzing material for the purchasing department.

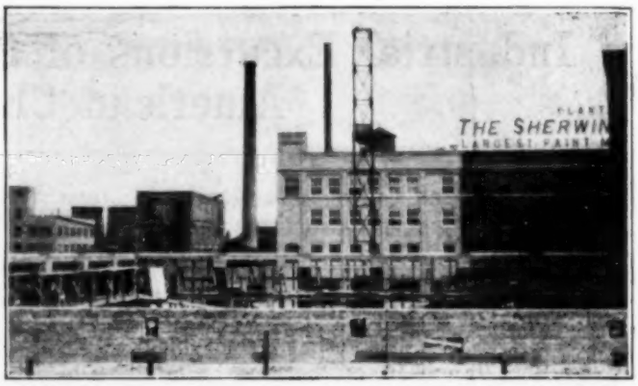
The company is also engaged in the manufacture of automobile bodies.

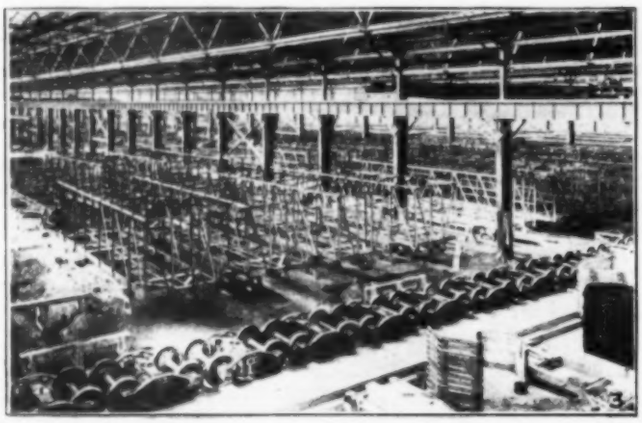
Fleischmann Co.

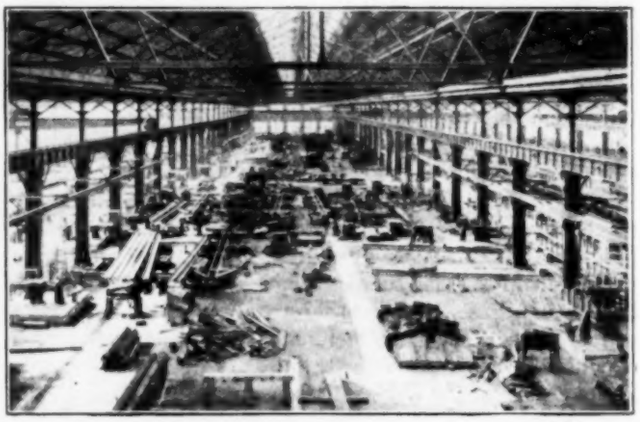
This plant manufactures cider vinegar, malt vinegar, white wine vinegar and yeast. The most interesting process inspected by the members of the society was the manufacture of yeast.

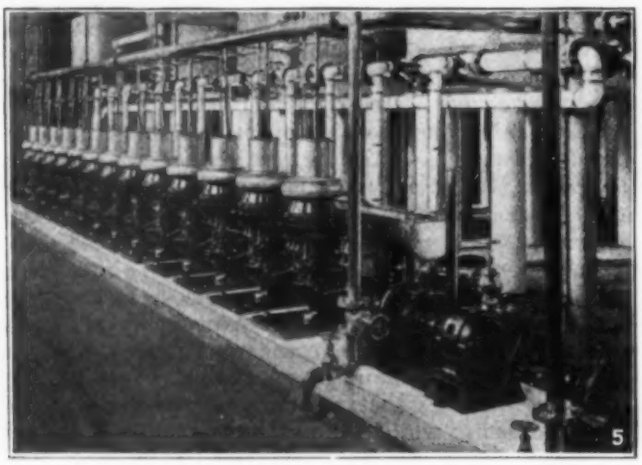
This is made from a mixture of corn, rye and barley malt. The grain, on arriving at the factory, is first subjected to a cleansing process by which all dust and any foreign substances are removed. Grains are subsequently ground separately in regular milling machines of the same type as those used for grinding wheat in the manufacture of flour.

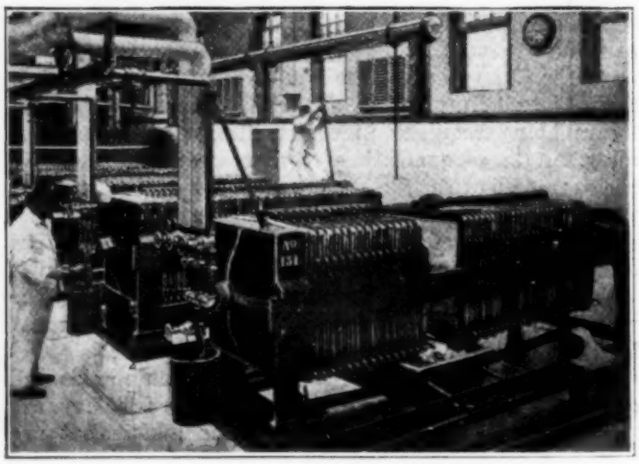












FIGS. 1 TO 6

Fig. 1. Cupolas in Doehler foundry.
Fig. 2. Sherwin-Williams plant.
Fig. 3. Erecting shop of the Pullman Co.
Fig. 4. Machine shop of the Pullman Co.
Fig. 5. Centrifugal yeast separators.
Fig. 6. Yeast presses.

The preparation of the mash consists of setting the ground grains to soak in filtered water. This has the effect of softening the starch, and in order that the final solution may contain all the elements for nourishing the yeast cells, the different grains are treated in distinct ways. For example, the corn is mashed at a high temperature, the rye being put into the mash after the corn is cooked. Malt at a lower temperature is added to convert the starch of the corn and rye into sugar. This is accomplished by the diastatic power of malt. The mash itself is sweet and contains no alcohol.

The next step is the addition of lactic acid bacteria. During this process the temperature is carefully regulated and within sixteen hours the lactic bacteria have multiplied to such an extent that the mash has a distinctly sour taste.

Upon completion of the lactic process the mash is run into filter tubs having perforated bottoms. The solid particles of the grain are held back and a perfectly clear extract known as wort is obtained by the filtration. This is then heated to a high temperature to remove other bacteria besides the lactic ferment. The wort is then conducted through pipes into huge copper tanks (fermenters). In these tanks specially prepared pure culture yeast is introduced. Compressed air is forced in, the oxygen in the air aiding the growth and reproduction of the yeast cells from the mother or culture yeast first introduced. During this process the temperature of the wort is carefully controlled by a system of cold-water coils in the fermenters; the yeast cells under proper conditions of temperature and aëration multiply very rapidly and in about twelve hours a large amount of yeast substance is formed.

The yeast substance is then separated from the liquid by means of centrifugal separators shown in Fig. 5 in the same manner that cream is divided from milk.

The yeast leaves these separators in fluid form like heavy cream and is conveyed by pumps through a cooling apparatus into a receiving tank and from there into a series of filter presses. Here the superfluous water is squeezed out and compressed yeast remains in the

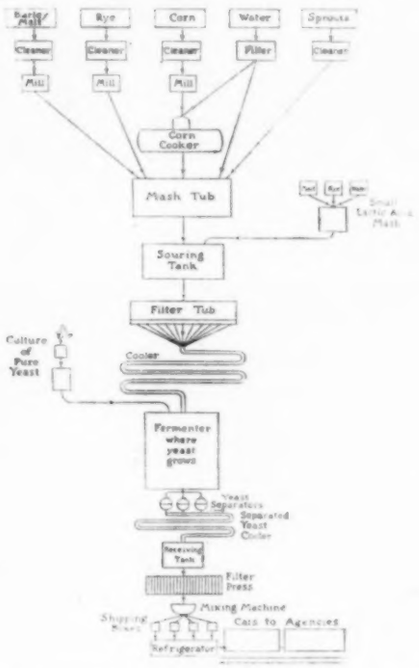


FIG. 7. DIAGRAM OF YEAST MANUFACTURE

presses. After removal from the presses the yeast is thoroughly mixed by machinery, packed by hydraulic pressure in 80-lb. boxes, and placed in a large refrigerator. A flow-sheet of the complete operation of the plant is shown in Fig. 7.

STEEL & TUBE CO. OF AMERICA

This plant is one of the most modern in type of equipment of any in the United States. It has every known labor-saving and safety device for increasing the output and protecting the workers. About 2,000 men are employed at the present time and the output is between 1,500 and 2,000 tons of steel per day.

Ore is unloaded from the steamers from the Lake Superior regions by cranes at a point where it can be easily transferred to the blast furnaces. Approximately 100 tons of coal is used at the plant every hour in the coking operation. Between 15,000,000 and 16,000,000 cu.ft. of gas is made every day. This gas is consumed in the steel plant.

A bessemer plant is now under construction as an addition to these works. Improvements will include a cupola, mixer and converter building, bottom house, office building, power plant and boiler houses. The cupola building will contain three cupolas each having a capacity of 40 tons per hour. This is quite an addition to the colonies of steel mills on the lake shore in the Chicago district.

One of the features of operation of this plant is the new town which is being built to house employees. About 200 houses have been built, together with a boarding house containing fifty rooms. The town is complete in every respect, containing garages, stores, sewage and water systems with capacity to supply the town. The houses are of masonry construction with hollow-tile walls, stucco on the outside.

THE NORTHWESTERN TERRA COTTA CO.

In addition to the brief outline given on page 370 of CHEMICAL & METALLURGICAL ENGINEERING, vol. 23, No. 9, the most recent development of this large ceramic ware plant is the addition of the new 320-ft. Dressler tunnel kiln. It is estimated that the efficiency of fuel consumption is 75 per cent, against 10 per cent efficiency in the periodic type of kiln. Without a doubt the tunnel kiln is the coming method of burning in the ceramic industries just as the byproduct coke oven has superseded the beehive type for the production of coke. Fig. 8 shows a car of ware entering the kiln. Fig. 9 shows the exit end. Note the sheet-iron jacket at this end, which absorbs the heat in the cooling zone and transfers it to the carrier drive on the upper floors. Fig. 10 shows the pipe for conveying the heat away from the kiln in the cooling section. Fig. 11 shows the walls and arch of the kiln during process of construction. Fig. 12 shows the construction of the section at the head end of the kiln. Figs. 13, 14 and 15 are additional views of the kiln during the erection.

While the temperature in the main heating zone reaches 2,100 deg. F., the construction of the brickwork and car is such that the track and iron trucks of the car were so cool a piece of paper laid between the rails would not be scorched by the heat above.

THE FANSTEEL PRODUCTS CO.

Fig. 16 shows a general view of this plant, and while the process of manufacturing tungsten has been described in CHEMICAL & METALLURGICAL ENGINEERING, vol. 22, No. 1, page 9, the research laboratory of the company is now concentrating on improving the process for the manufacture of molybdenum mainly because it is a more ductile and easily workable metal.

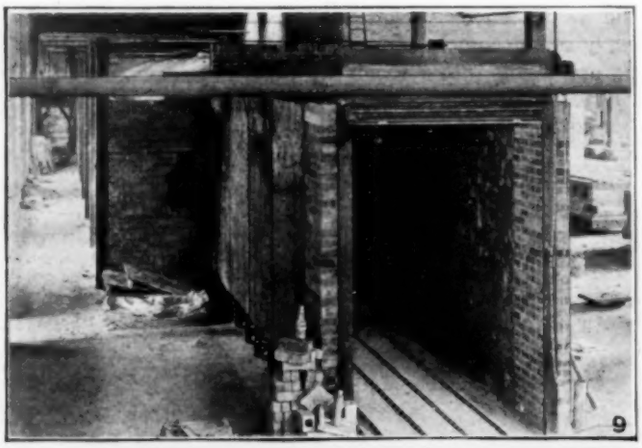
The company manufactures molybdenum metal principally for supplying the electrical trade, and for the manufacture of its own electric furnaces used in working tungsten metal. A very considerable amount of molybdenum goes to vacuum tube or audion manufacturers for plates in wireless telegraphy. Its low coefficient of expansion, which enables it to be welded to Pyrex glass, makes it extremely desirable in this connection. It has a melting point of approximately 2,500 deg. C. and a relatively low vapor pressure.

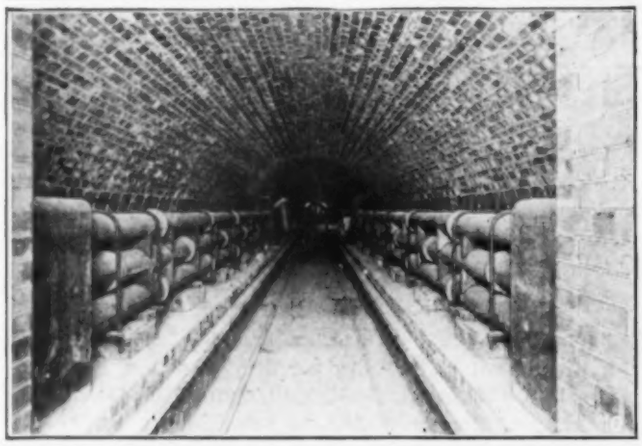
Generally speaking, the Fansteel company starts from commercial molybdic acid, although at present it is running down a small quantity of molybdenite, MoS_2, by roasting on a cast-iron base. This method is the commercial method and could be worked out to give a very satisfactory product. It is also possible to break up the molybdenite with nitric acid, leaving a molybdic oxide. The latter, however, is expensive and not particularly efficient.

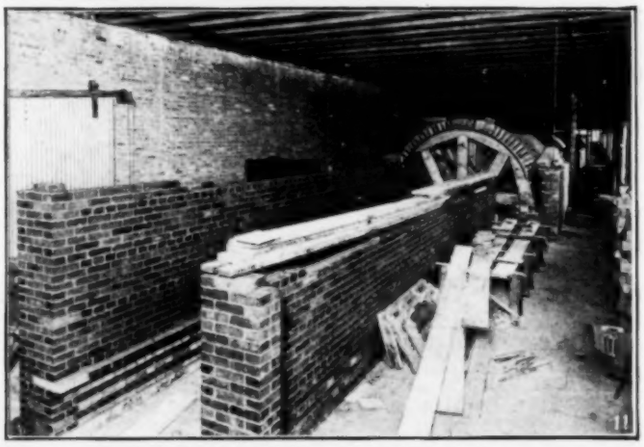
The product of roasting is dissolved in ammonia, filtered and precipitated with nitric acid. This gives a relatively pure molybdic acid which is then ignited at a temperature below 1,000 deg. C. to molybdic oxide, a pale yellow-brown material.

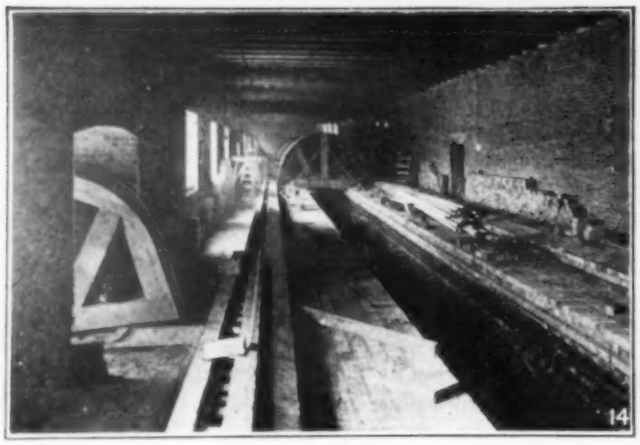
It is necessary in the purification process to be sure that copper and all the alkali earth metals are eliminated. Their presence in the actual metal is of little consequence except that they retard seriously the reducing of the oxide to metal by preventing the removal of oxygen.

Molybdenum is reduced from the ignited oxide in nickel or nichrome trays placed in iron tubes. A stream of hydrogen previously dried and purified is run through



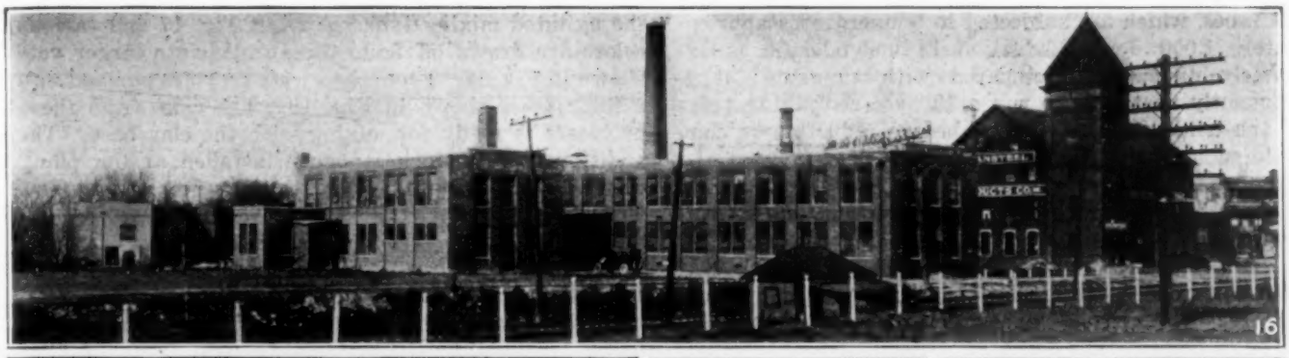


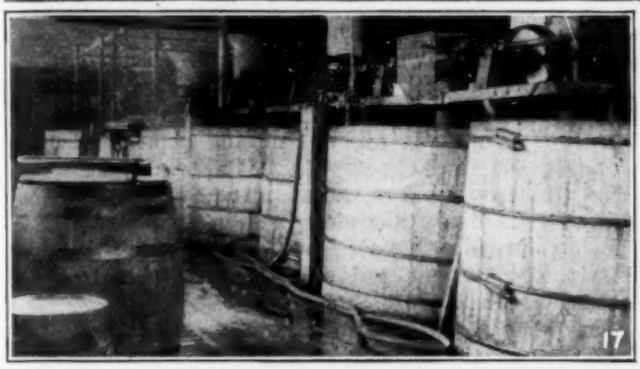


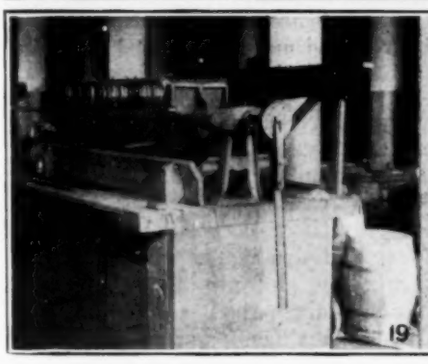


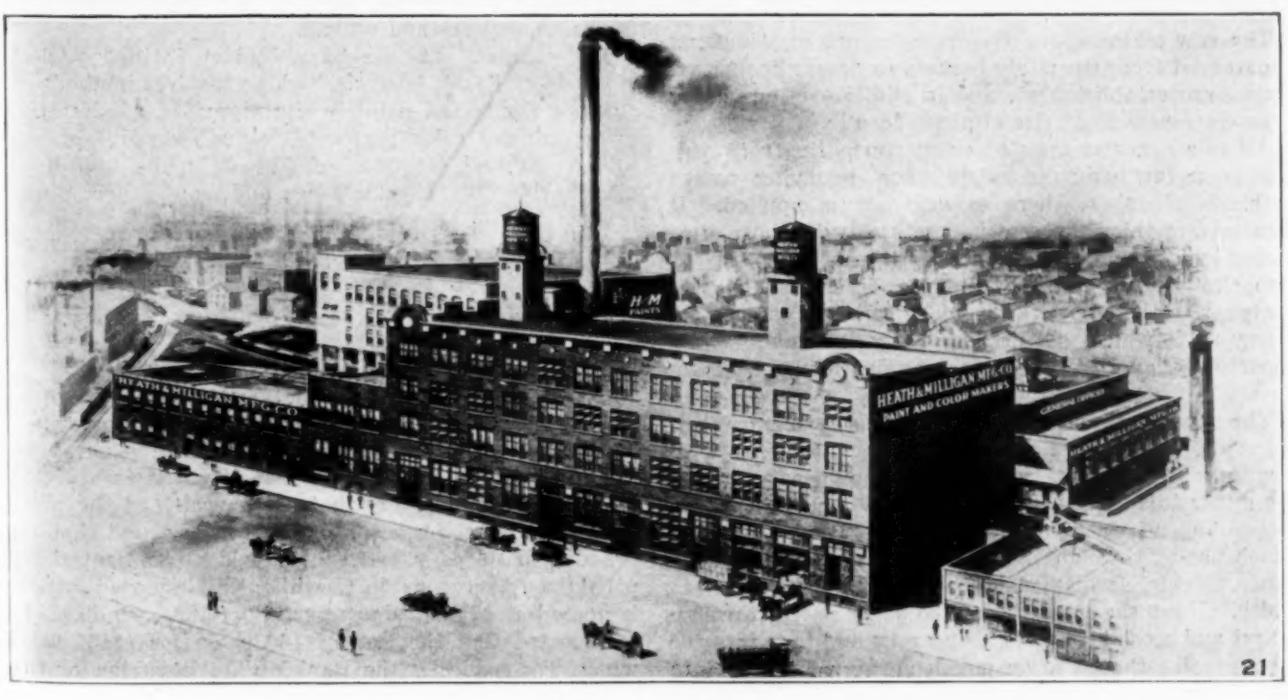
FIGS. 8 TO 15. DRESSLER TUNNEL KILN INSTALLATION

Fig. 8. Car of ware entering kiln.
Fig. 9. Exit.
Fig. 10. Pipe heat conveyor.
Fig. 11. Kiln walls and arch in construction.
Fig. 12. Construction of head of kiln.
Figs. 13 to 15. Views of construction.









FIGS. 16 TO 21.

Fig. 16. Fansteel Products Co. Fig. 17. Color mixing tank. Fig. 18. Color vats. Fig. 19. Filter presses. Fig. 20. Kaolin mixers. Fig. 21. Heath & Milligan Co. plant.

the tubes, which are subjected to temperatures approximately 1,000 deg. Reduction of molybdenum is extremely difficult as compared with tungsten; it is frequently necessary to run a furnace containing trays of the oxide for forty hours before reduction is complete enough to make a workable metal.

The metal powder is removed from the boats, screened and pressed into bars in a hydraulic press, the process varying from that of tungsten only in minor details.

The pressed sticks of metal are placed between electrodes of an electric furnace and brought up to approximately 2,400 deg. C. by passing an electric current through them. This operation is, of course, performed in an atmosphere of hydrogen. The molybdenum shrinks very considerably and the follow-up on the electrodes must be unusually long in order to develop sufficient grain growth in one operation. The ingots must not show any cracks except very slight ones at the end, unavoidable because of the cooling effect of the electrode.

The material is then rolled into sheets, or may be swaged round in ordinary swaging machines. The drawing operation in the manufacture of molybdenum wire may begin as large as 0.100 in. A piece $\frac{1}{8}$ in. in diameter may be bent cold in a radius of approximately 3 in. The material is machinable and is highly resistant to most alkalis and acids. It takes a very high polish.

The Fansteel company is issuing a series of loose-leaf sheets which it is intended will cover the subjects of tungsten and molybdenum with some thoroughness. Arrangements have been made so that copies of these sheets may be secured on application.

The laboratory of the company is engaged in assembling data for publication from its extensive work with both metals.

Sears, Roebuck & Co.

Four departments of the plant were visited by the members—namely, the color plant, the paper mill, the wallpaper printing mill and the shade-mounting department.

The raw material for the manufacture of wallpaper is gathered from the waste baskets in Sears, Roebuck & Co.'s large establishment, and in addition is purchased from employees at a price of about 2c. a lb.

All this paper is unbaled on platforms in front of a dust remover, which consists of a revolving screen within a chamber where exhaust air is applied. It comes from this dust remover onto a belt, where it is picked by hand and the various qualities of scrap thrown into chutes. From these chutes it is carried by belt conveyor to the various bins. The company is erecting a new plant which will produce forty-five tons of wallpaper daily, against the present production of eighteen tons.

The paper is pulped in hot water at a temperature of about 140 deg. F. in a mixer, while color, together with a rosin sizing binder, is added. The pulp passes from the mixer to a screen, where the heavy particles are removed and returned for further mastication. Material which passes through the screen goes to a Fourdrinier paper machine, which makes a roll of about 40 in. in width. From the Fourdrinier the paper passes through a first and second set of pressing rolls and then into the drying rolls, thence to large calenders, and finally into the slitter and winder, where it is cut to 19½ in. widths —the standard size for wallpaper.

The color plant employs vegetable, mineral and coal-tar dyes. The individual ingredients are dumped into the agitated mixing tank shown in Fig. 17 and various colors are drawn off from these tanks into larger vats shown in Fig. 18. From these vats they are pumped into a filter press shown in Fig. 19. The cake from these processes is ready for mixing with the clay base. The additional unit which is being installed at the plant, instead of a filter press, includes a 6 x 6-ft. Oliver filter wheel.

The clay, which is a South Carolina kaolin, is beaten to a creamy mixture in the apparatus shown in Fig. 20 and then pumped to mixing tanks on the upper floor.

In these tanks the ground coat for printing on the paper is colored by the material brought from the filter presses. The other inks which go over this ground coat are mixed by hand with the clay in tanks near by. One of the printing machines applies a varnish coat which goes on over the color. It is a cold cut gum spirit tile varnish. A specialty oil-color mixing plant is also in operation and is equipped with Kestner & Hecht apparatus throughout. The departments auxiliary to the wallpaper plant are a modern white tile laboratory, a complete machine repair shop, a wallpaper catalog printing department and a roller manufacturing department.

The rollers from which the designs are printed onto the wallpaper are made of wood, the designs being hammered in from cut pieces of brass. After the pattern is thus made on the roll the metal is turned down to exact diameter for the presses.

Heath & Milligan Co.

This is a modern and well-operated plant for the grinding and mixing of various paints and colors. Some of the raw materials used are English whiting, barytes, white mineral primer, arctic zinc, polar zinc, Carter white lead and National white lead. The various departments involve the grinding and mixing of enamels, varnish, paint, heavy outdoor paints and dry colors.

The laboratory of this plant has done a large amount of research work in the past and is completely equipped for paint analyses and control.

The company has issued a booklet entitled "Select Methods of Paint Analysis," which involves methods of analysis for mixed paint, white pigments, sulphur trioxide, various color pigments, including red lead and orange mineral, analyses of Chinese white and blue, ultramarine blue, chrome green and many other special products.

Since this company has been recently purchased by the Glidden Varnish Co., the research work will probably be carried on elsewhere.

New Sulphuric Acid Plant for Montevideo

A factory, equipped with the most modern apparatus for the production of sulphuric acid in large quantities has been installed recently in Montevideo as an annex to the Chemical Institute in that city. It is reported by Consul David Myers that the capacity of the plant is greater than the needs of the country, and that its product, of 66 deg. test, can be sold at 8.5 centesimos per kilo (3.98c. per lb.), while the imported article is quoted at 10 centesimos per kilo (4.69c. per lb.). It is expected that the loan of 130,000 pesos ($134,420), which was made by the Bank of the Republic for the installation of the laboratory, will be paid by the profits of the establishment within ten years. The name of the director of the Chemical Institute, who is an American, may be obtained from the Latin American Division.

The Manufacture of Lime for Chemical and Metallurgical Purposes*—I

A Description of Shaft Kilns, Their Design, Construction and Method of Operation—An Improved Shaft Kiln With Reinforced Concrete Shell—Furnace Box and Arch—Cooling Cone—Distribution of Heat—Fuels and Their Consumption

By RICHARD K. MEADE

KILNS employed for burning lime may be divided into two classes—intermittent kilns and continuous kilns. The latter class in turn may be subdivided into rotary kilns and shaft kilns. The shaft kilns may be again subdivided into mixed-feed and separate-feed kilns.

The intermittent kilns are usually known as "pot kilns" from their shape. They are primitive, uneconomical and are seldom used except for burning lime for the farm, where they are employed to some extent because they are inexpensive to construct, as they can be built of rough local stone. These pot kilns are built in the side of a hill in order that the limestone may be dumped into the top by means of carts.

In charging such kilns, an arch of the larger pieces of limestone is first built 2 to 3 ft. from the ground and the limestone to be burned is piled on top of this, using pieces averaging in size from 2 to 8 in. thick. A wood fire is started below the arch and the flames from this pass up through openings in the latter and between the stone. The fire is usually maintained for about two days, when the kiln is cooled. Old kilns of this sort are to be seen along the roads in any limestone country.

Continuous Shaft Kilns

As has been noted, the continuous shaft kilns may have either a mixed feed or separate feed. Both types are used for producing chemical and metallurgical lime. In the former class, the fuel comes in contact with the limestone; in the latter, the fuel is burned on grates and only the products of combustion come in contact with the limestone. The common type of mixed-feed kiln employed by lime manufacturers is similar in design to a large pot kiln, but is equipped with gates at the bottom of the kiln through which the lime may be drawn as burned.

Vertical kilns of mixed-feed type used in chemical plants are very similar to the separate-feed kilns described further on except that they are not provided with fireboxes on the side of the shaft. They consist generally of a shaft 40 to 50 ft. high lined with firebrick and covered either with a steel jacket or with steel bands. They are equipped with gates through which the lime may be drawn at regular intervals from below. When such kilns are used in the sugar and soda industries they are provided with a closed top and the products of combustion are drawn off by means of a fan in order that the carbon dioxide may be utilized. No detailed description of such kilns need be given, as in a well-constructed mixed-feed kiln the structural features are quite similar to those described further on for separate-feed kilns.

In charging such a kiln, the fuel (coke or small size anthracite coal) and limestone are added in alternate layers. Fire is started at the bottom and works its way up. The process of charging and drawing the kilns is continuous. These kilns are economical of fuel and for the same size kiln give a larger quantity of product than that given by the vertical kilns with separate feed. Their exit gases are also usually somewhat richer in carbon dioxide. On the other hand, the lime is contaminated by the ash of the fuel. When such lime is used for building purposes or for metallurgical work, it must be carefully sorted in order to discard the lumps to which the fuel ash has adhered. Where the lime is to be slaked for milk of lime, the separation of the ash and the lime can usually be effected by passing the milk through a screen, or where used to causticize, by placing the lime in a wire cloth basket and dipping in the causticizing tank.

Improved Shaft Kiln

The vertical kiln with separate feed usually consists of a steel cylinder lined with firebrick, into the top of which the limestone is charged. The kiln is heated by from two to four dutch ovens built into the side of this so that the products of combustion pass into the latter while the ash of the fuel remains on the grates. The burning is done in the zone between the ports of the furnaces. The lime is drawn out below.

Fig. 2 illustrates a shaft kiln designed by the writer which may be taken as fairly representative of this type of kiln. There is nothing very original about the general design, but the lines have been so worked out as to give the proper fuel economy and quality of lime. Added to this are certain features intended to facilitate the operation of the kiln, cut down repairs, cheapen the construction, etc.

The dimensions of the kiln are altered usually to suit local conditions and the lime to be burned. With soft limestone, the kiln is not usually made so high as with the hard stone, because the former will not stand so great a weight of stone without crumbling. Where the limestone is hard to burn, the diameter is usually less, while with easy burning material such as dolomite, the diameter is greater. The diameter is also increased where gas is used as fuel.

Generally speaking, the kiln consists of a steel shell 11 ft. in diameter and about 38 ft. high. This shell rests on a solid block of concrete and terminates in a steel cooling cone. This shell is divided into two parts. The upper 5 to 6 ft. is unlined and forms a

*Read before the American Institute of Chemical Engineers, Montreal, June 28, 1920.

bin for the storage of the stone so that the kiln does not have to be continuously charged. The lower section of about 32 ft. is lined with firebrick, and in this the stone is burned.

Furnace and Cooling Cone

The kiln is equipped with two furnaces, one on each side. These are supported on a reinforced concrete floor level with the bottom of the shell and 12 ft. above the floor on which the lime is drawn. Usually the reinforced concrete firing floor is extended from 10 to 20 ft. beyond the firebox front in order to give ample space for the burners to work and on which to pile the coal for burning, etc.

The cooling cone is of steel plate and is so placed that the air can circulate freely around it. This cone receives the red hot lime from the burning zone of the kiln. The function of the cone is to cool the lime. The bottom of the cone is closed by means of a pair of doors which swing from pivots supported by two small I-beams. The doors are pulled outward by means of a pair of levers when the lime is to be discharged and pushed shut when this has taken place. The cone is far enough from the floor to allow a car to be run under the doors into which the lime is discharged. The levers operating the doors are located outside of the kiln and permit the operator to stand away from the dust and heat while the lime is being drawn. The doors can be adjusted to give a close fit to the bottom of the cone. There is a free passage entirely around the cone and no blocking up occurs as in most other forms of discharge. The cone is provided with a poke hole closed by a sliding shutter to be used in case the lime does not discharge freely due to arching. In some of the writer's newer kilns he has placed a water-jacket around the upper part of the cone in order to increase the life of this.

The track by means of which the kilns are charged passes over one side of the kiln so that the cars dump directly into the center of the kiln, giving an even distribution of the charge. The track is supported on light steel I-beams and a platform of perforated metal supported by brackets and inclosed by railings runs around the top of the kiln and between the rails. A heavy ring of steel plate protects the top of the brick from damage by the falling stone.

Where these kilns are used for building lime it is usual to carry the lime from them by means of barrows or cars. A more approved method, however, would be to place a pan conveyor under the cooling cone and draw the lime immediately onto this and so convey it to the point of use.

Reinforced Concrete Shell

During the last few years the cost of the steel jacket for the kiln has been quite an item and a cheaper material which could be substituted for this has been desirable. Having great faith in reinforced concrete, this latter material naturally suggested itself to the writer.

As the result, plans were drawn about three years ago for two kilns with reinforced concrete shells which were built at a small plant in Virginia. These have been in use for several years, long enough to show that the material and form of construction are entirely satisfactory. Since these were built the writer has designed reinforced concrete kilns for several other lime plants. There are other advantages in this form of construction besides cheapness, the principal ones being that the shells do not have to be painted, as they are not subject to corrosion, and there is less loss of heat by radiation.

The reinforced concrete kiln does not differ very materially from that which I have illustrated. Proper means are, of course, taken to heat-insulate the concrete shell. The cooling cone is made of steel and there is the same unlined top serving as a stone bin.

The arches over the furnace ports are a weak point in the shaft kiln. These arches are not only subject to destruction from the heat but they carry the weight of the lining, etc., above them. In the reinforced concrete kiln, this weight has been taken off of the arch by means of a reinforced concrete girder extending over the firebox.

Draft and Distribution of Heat

With all types of shaft kiln one of the points to be watched is the draft. This must be so regulated by the design that the contents will be uniformly heated, otherwise some of the lime will be overburned and some of it not burned enough. In some instances stacks are placed on the shaft in order to induce a better draft. Induced draft is also employed, the products of combustion being sucked from the top of the kiln by means of an exhauster. Where this is done it is, of course, necessary to close the top of the kiln and to charge the limestone into the latter through a door or a charging "bell" somewhat similar to that of a blast furnace. Fig. 3 shows such an arrangement. When the kiln gases are drawn off for their carbon dioxide this bell type is generally employed.

A less satisfactory method of artificial draft is to force the fire by means of a blast below the grates. This usually takes the form of a steam blower. If

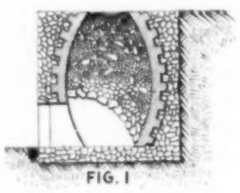


FIG. 1

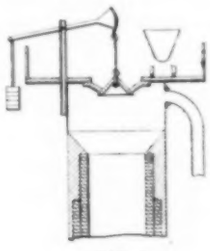


FIG. 3

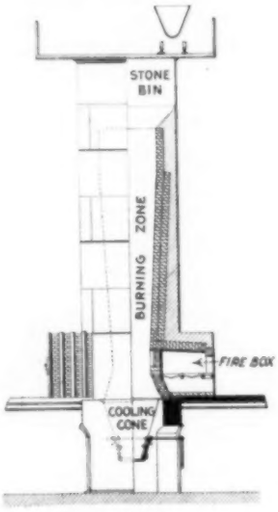


FIG. 2

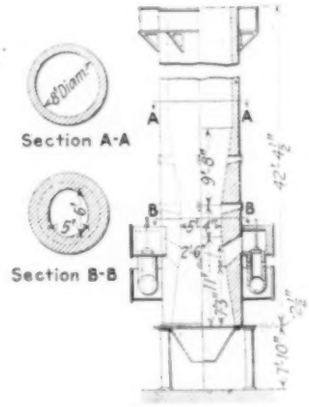


FIG. 4

Fig. 1. Old style pot kiln. Fig. 2. Shaft kiln with separate feed. Fig. 3. Closed top for shaft kiln. Fig. 4. Producer gas-fired kiln.

the fire is blown, there is a tendency for the flames to come out around the furnace door rather than to pass through the shaft, but the steam itself is beneficial.

If the kilns are too large in diameter, the heat will usually not carry to their centers and so the stone in the center of the kiln will not be burned properly. The writer has found that, owing to the fact that the gases from the firebox show a tendency to hug the sides of the kiln, the latter may be made of greater diameter across the center line of the fireboxes than along this line. This makes a horizontal cross-section of the kiln at the fireboxes elliptical in shape. Two sides of the kiln are straight down to the cooling cone, while the other two sides are drawn in slightly as shown in Fig. 2. If drawn in too much, and with some stone if drawn in at all, the charge will stick and hang up in the kiln.

The lime is usually drawn every three to six hours, although a few plants draw oftener and some less frequently. Large kilns are sometimes provided with a continuous draw. The objection to drawing too often is that each time the lime is drawn cold air enters the kiln through the drawing doors and cools off the charge. This same objection has been raised to kilns provided with a continuous draw—namely, the continual current of air entering where the lime is drawn passes up through the center of the kiln and prevents the proper burning of the lime at this point.

The charge sometimes sticks in the kiln, and openings closed by proper means are usually left on both sides of the shaft just above the furnaces through which bars may be introduced. It is claimed that kilns lined with silica brick show less "hanging up" than kilns lined with ordinary firebrick, due to the fact that the silica brick lining very soon scorifies and becomes smooth.

Fuels and Their Consumption

This type of kiln may be heated by wood, coal, oil, natural or producer gas. Wood is supposed to burn a better quality of lime than any other fuel, due to the low temperature of the flame and the length of this, and for this reason it is sometimes used for burning building lime; but it is very seldom used for burning chemical and metallurgical lime owing to its cost. The majority of kilns of the type given employ coal. This should be what is known as "long flame" coal, high in volatile matter and preferably low in sulphur and ash.

Where obtainable, oil makes an excellent fuel. When it is used in the kiln described, the burner is placed in the door openings of the fireboxes and these are bricked in with firebrick, leaving openings for the burner and for observing the lime, etc. The grate bars, if already in place, are covered with firebrick, or if a new kiln, the firebox is simply filled up to the point of the grate bars with some suitable material and covered with firebrick.

Natural gas may be used in this kiln and also producer gas, but better results can be obtained by modifying the lines of the kiln to suit this latter fuel.

Producer gas is quite extensively employed for burning lime. Its advantages and disadvantages are a matter of dispute. One of the principal good points is the fact that very much larger gas-fired kilns can be built than is possible with hand firing. Some of the more recent gas-fired kilns have a capacity of from forty to sixty tons of lime per day each. This increased size of the kiln is made possible by the introduction of gas and air at various points around the kiln so as to obtain uniform temperatures throughout the stack. Fig. 4 shows a gas-fired kiln.

Producer-gas kilns are slightly more economical of both fuel and labor than grate-fired kilns. Unless carefully handled, however, they give lime which is unevenly burned. More skill is required in burning lime with producer gas than with any other fuel, and considerable experimenting is usually done before satisfactory results are obtained.

In applying producer gas to vertical kilns, the main points to be watched are proper mixing of the gas and air in the shaft and preventing the accumulation of lime in the gas ports. This latter blocks the flow of gas, causing irregular distribution of the heat and hence under-burning of the lime in certain parts of the shaft. In the type illustrated this trouble has been avoided by sloping the gas ducts downward toward the kiln. The points given further on in this

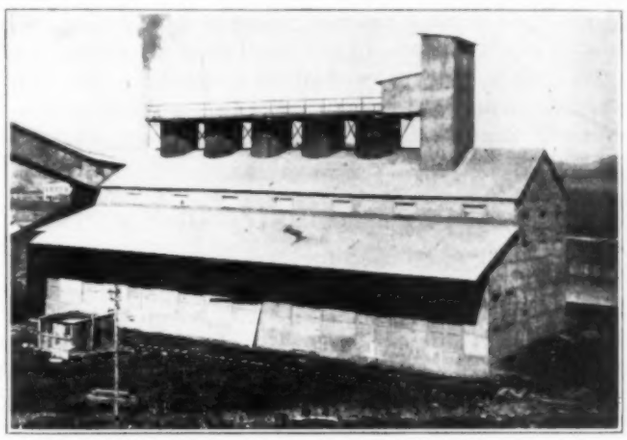


FIG. 5. LIMEKILNS OF THE CLINCHFIELD PORTLAND CEMENT CO.

series under "Producers for Heating the Rotary Kiln" follow also with the vertical.

The shaft kiln described, heated with wood, coal or oil, will produce from eight to twelve tons per day depending on the kiln and quality of the limestone employed. When fired with gas the capacity will be from seventeen to twenty-five tons.

Quantity of Fuel Required

The quantity of fuel required varies also and depends on many things, among which may be mentioned the kind and quality of fuel, skill of the operator and the limestone itself. Magnesian stone burns more easily than high-calcium stone. The amount of fuel actually required is about as follows:

One ton of good bituminous coal hand fired will burn from three and one-half to four tons of lime.

One ton of good bituminous coal in the gas producer will burn from three and one-half to five tons of lime.

One barrel of fuel oil will burn one to one and one-quarter tons of lime.

One cord of seasoned hard wood will burn from two and one-quarter tons to two and three-quarters tons of lime.

The problem of carrying the stone to the top of the kilns is usually taken care of, where the kilns are lo-

cated at the quarry, by means of a hoist and an incline, the latter running from the quarry floor to the top of the kiln. At chemical plants where the stone is brought in by rail the incline may be used, or in many cases a platform elevator is to be found more satisfactory because of the room saved.

A plan adopted at one of the plants designed by the writer would no doubt be satisfactory in many chemical works. In this plant the railroad cars are pushed on a trestle over storage bins. Each bin has an iron chute closed by a swinging gate through which the stone is discharged. A track extends in front of the stone bins and 9 ft. below the bottom of them and the stone is discharged through the chutes into small side dump cars, which are pushed along the track into the lime plant. The track is covered by a shed so that the drawing of the stone is not interrupted by bad weather. The cars after entering the kiln building are carried to the top of the kilns by a platform elevator.

Fig. 5 shows a battery of shaft kilns. Where only eight to twenty tons of chemical lime is required one or two shaft kilns will prove the best plant, but where larger outputs of chemical lime are needed the rotary plant will prove more economical.

Parts II and III, dealing with Rotary Kilns and Operation, respectively, will appear in subsequent issues.

The Camphor Industry in Foochow

TREES fit to be used for camphor distillation must be at least twenty years old. When a suitable tree is found a crude native distillery is set up at the spot. This consists of a boiler, with an iron base and a wooden top, connected to a distilling vat partly filled with water. The camphor upon being conducted to the vat precipitates as crystals on the inner walls, while the non-precipitable portions drop down as oil, which floats upon the water. About 5¼ lb. of camphor and camphor oil, in the proportions of 70 per cent camphor and 30 per cent camphor oil, can be produced from 240 lb. of chips.

The districts where most of this initial distillation is done are Kienning, Yuchi, Yungan, Yenping, Tatien, Shaowu, Shahsien and Ningte, reports Vice-Consul E. B. Price, in *Commerce Reports*.

It is almost impossible to say how many men are engaged in the industry, but there cannot be many. Their wages are equal at the present rate of exchange to about $0.38 a day.

The crude product is carried by porters to the Min River or one of its tributaries, and then carried to Foochow by native boat. Boat hire is approximately $1 per cwt. from the interior to Foochow.

How Marketing Is Done

The marketing of camphor is done very largely through brokers in Hongkong. The distilleries seldom do their own marketing, with the exception of the Japanese and Portuguese. There are also brokers in Foochow able to handle foreign orders in the English language.

It should be borne in mind that the camphor market is an extremely sensitive and dangerous one for the uninitiated. The factors of supply, governmental supervision, freights, stocks in Foochow and Hongkong, and three markets—Foochow, Hongkong and the foreign market—all enter into the situation. Hence no better scheme than the brokerage system can be suggested, unless the foreign buyer is prepared either to go into the producing end of it or into the buying and holding of considerable stocks himself.

Distillation of the Oil

The product as it leaves the distillery in the interior consists of crystals and camphor oil. The crystals are ready for marketing, but the oil is put through a process of redistillation at Foochow. This process is a simple one, and need not be described here in detail. The effect is to distill from the oil all the remaining camphor; 133 lb. of oil produces 64 lb. of camphor and 27 lb. of desolated oil. The camphor derived from oil is of a cheaper grade than that derived originally from the wood chips. The desolated oil is used as a base for dyes and paints.

There are twelve of these distilleries in Foochow which produce camphor from the oil. They are known as the Yuan Cheng, Hsing Chi, Cheng Chi, Hsiang Chi, Fu Sheng, Hsieh Chi, Kao Fang and Tao Ho—all Chinese; Ting Te—Portuguese; and Mitsui Bussan Kaisha and Tai Hua—Japanese. When working, each distillery produces on an average 325 lb. of camphor a day.

The Government Camphor Bureau

The various districts producing camphor have each an official camphor bureau under the control of the Provincial Commissioner of Industry. Each bureau has the authority within the district it covers to collect certain taxes and to buy camphor trees and distill camphor. In American currency the tax is approximately $6 on every 133 lb. of camphor in transit. The taxes collected and the camphor produced are sent to another government bureau called the Fukien Government Camphor Industry, Transportation and Tax Collection Office. Its duties are to take in and turn over to the provincial government the taxes remitted by the various district bureaus and to take in and market the camphor that is received.

There is still a third bureau which has authority to buy camphor oil and distill it into camphor, marketing its product independently.

Private producers must take out licenses and agree to pay the taxes hereinbefore mentioned. In addition to this there is a license fee of $2 local currency per month per vat.

Regulations for Foreigners

Foreigners wishing to go or send into the interior to purchase camphor under what is known as the "transit pass" system, permitted by treaty, may still do so. Under this system the foreign exporter may bring the native product to the seaboard and export it to a foreign country by paying the regular 5 per cent export duty plus a surtax of half the export duty. The foreigner may purchase either from the private producers or from the government bureau. The effect of the government bureau system is to tax the product just the same, because the foreigner may not operate his own distillery in the interior, and government taxes are imposed on the distillery and its product before the foreigner purchases the camphor.

Japanese distilleries operating in the city of Foochow are not taxed, according to information given by the Japanese consulate in Foochow.

Synopsis of Recent Chemical & Metallurgical Literature

Titanium Pigment Industry in Norway.—In view of the growing importance and increasing output of titanium dioxide as a pigment in active competition with lithopone, the *Chemical Trade Journal and Chemical Engineer* has published (Sept. 25, 1920, p. 407) a short account of the process used by the Titan Co. of Fredrikstad, Norway.

Although extensive deposits of titanium ore are found in the New World, Africa and Australia, the only deposits of any importance in Europe occur in Scandinavia and in the Urals, where the titanium oxide is found in combination with iron oxide, as titaniferous iron ore or ilmenite. The most interesting deposits in Scandinavia are found in Norway, in Sogndal, south of Rgersund, at Raagefjord, and Jössingfjord. These are Laxedalsfelterne, with ore containing about 35 per cent of TiO_2, in quantity 250,000 tons; Blaafjeldet, with ore containing about 40 to 45 per cent TiO_2, in quantity about 100,000 tons; and Storgargen, with ore containing about 25 to 40 per cent TiO_2, in quantity about 3,000,000 tons. It is from the two latter deposits that the Titan Co. obtains its ore.

The ore is sorted, pulverized, classified and washed over washing boards. The dressed ore is now carried seven kilometers by rail to Raagefjord and from there shipped to Fredrikstad. After being dried and finely ground the ore is thoroughly mixed with sulphuric acid in a special mixing apparatus, and the mixture is then transferred to a decomposition plant, where the reaction between the acid and the ore is started by gas heating. The apparatus works continuously and delivers the decomposed titanium ore and sulphuric acid mass in the shape of cakes, in suitable sizes, which are crushed and ground and then dissolved in water. The titanium and iron solution obtained in this way contains particles of non-decomposed minerals. It is necessary to separate these particles from the solution. Filtration has been tried in every possible way, but the problem could not be solved in a practical manner. In the present process the undecomposed mineral is separated by settling in large vessels. Certain devices are used by which the speed of the settling is greatly accelerated. The quite clear solution is then electrolytically reduced, whereby the ferric iron is converted into ferrous iron. On boiling in a vessel provided with internal steam coils the titanium dioxide falls out as a white amorphous powder.

The elimination of ferrous sulphate and free sulphuric acid from this powder constituted one of the most difficult technical problems. It was impossible to find a suitable filter, both on account of the extreme fineness of the titanium oxide particles, and on account of the corroding effect of the acid solution. A washing system was eventually adopted, in which practically all the iron is removed. Traces of sulphuric acid are eliminated by the addition of barium carbonate, and so the final product contains a certain amount of barium sulphate. Very minute traces of iron—0.02 per cent—are sufficient to discolor the product, and the details of how the last small traces of iron are removed are not divulged, although it is suggested that it is effected by adding substances which form colorless compounds with iron. The product is calcined, ground to such a fineness that 99.95 per cent passes through a mesh of 5,000 to the sq.cm. The pigment is then mixed with linseed oil and a little zinc white is added. After thorough incorporation in the edge-runner mill, the product is ready for use.

As compared with white lead and zinc oxide, the advantages titanium-white offers are said to be considerable. It possesses a greater covering power than either, is non-poisonous and is chemically inert. Unlike zinc oxide, it exerts no saponifying action upon the linseed oil. Its low specific gravity (4.0) renders it very easy to apply.

In connection with the experimental work on titanium-white, Prof. V. M. Goldschmidt, who microscopically investigated the differences in covering power of titanium-white in various states of subdivision, arrived at the conclusion that among other things the covering capacity of a pigment depends upon the difference between its own refractive index and that of the binder used, and in this connection it is interesting to note the following figures: If the refractive index of linseed oil be assumed to be = 1, then the refractive index of zinc oxide = 1.34, of white lead = 1.36, of amorphous titanic oxide = 1.48, and of crystallized titanic oxide in the shape of rutile = 1.80. This difference in refractive indices would seem to account for the greater covering capacity of titanium-white.

It is interesting to note in connection with the foregoing abstract that the titanium pigments which are being made in the United States by the Titanium Pigment Co. of Niagara Falls resemble lithopone both as to barium sulphate content and as to specific gravity. Thus, BXX Titanox (sp. gr. 4.28) consists of 25 per cent TiO_2 and 75 per cent $BaSO_4$, while a well-known brand of lithopone contains 30 per cent ZnS and 70 per cent $BaSO_4$, and has the same specific gravity (4.28).

Commercial Possibilities of Government Nitrate Plants.—The first issue of *Army Ordnance*, the organ of the Army Ordnance Officers Association, contains an interesting general article on the nitrate situation, written by Colonel JAMES H. BURNS, Chief of the Nitrate Division. It contains some new pictures of the Muscle Shoals nitrate plant. The author enters into the uses of nitrogen compounds in war and peace, the sources of supply and the Government developments in nitrogen fixation during the war. After touching upon the by-product coke-oven supply in peace time he writes as follows:

"We have made quite careful and thorough analyses of the costs of producing nitrogen compounds at the No. 2 Plant (Muscle Shoals), and as a result thereof we believe that the materials can be produced at a price that should be satisfactory to both the Government and the consumer . . . and it is our judgment that the market can easily absorb the products without appreciably interfering with the present sources."

Before outlining the War Department scheme for the solution of the problem of operating the nitrate plants as incorporated in the United States Fixed Nitrogen Corporation bill, now enjoying a position of prestige on the calendar when the Senate again convenes, the Government made every effort to lease or sell the plants to private interests, but met with no success. The article is a clear, concise and reasonable exposition of the Government's case.

Recent Chemical & Metallurgical Patents

British Patents

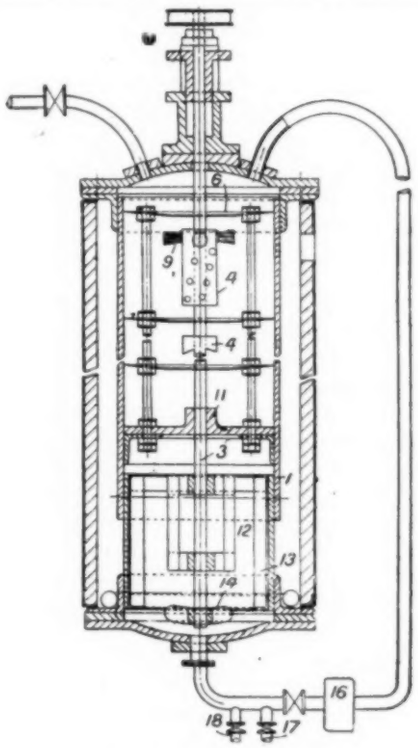
Complete specifications of any British patent may be obtained by remitting 25c. to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Treating Vegetable Fibers.—Vegetable fibers of all kinds, whether in the mass or in the form of lap, yarn of fabrics made therefrom, are given the character of wool and an increased affinity and absorbent capacity as regards basic and other dyestuffs, by precipitation thereon of products resulting from the action of concentrated nitric acid upon starch or other amylaceous substance, the precipitation being effected either by washing with water or by treating with dilute solutions of acids, bases or salts followed by washing with water. The fibers may be impregnated with the solution of starch, etc., in concentrated nitric acid, the excess being pressed out, and the nitrated amylaceous substance precipitated upon the fibers by washing; or the fibers are impregnated with a paste or aqueous solution of starch, etc., dried, passed into concentrated nitric acid, and the nitrated amylaceous substance precipitated upon the fibers by washing. Print effects may be obtained on plain fabrics by direct impression or by the use of resists either by means of a solution of starch or other amylaceous substance in concentrated nitric acid, or by means of a paste or aqueous solution of starch, etc., which is treated, after drying, with concentrated nitric acid, the fabric being, in each case, treated with water or with dilute solutions of acids, bases or salts followed by washing with water to precipitate the nitrated amylaceous product. In an example of treatment, a paste is prepared by heating together 40 kilos of maize starch and 75 liters each of water and acetic acid. The textile is dressed with the paste, dried, treated for three to five minutes with 72 per cent nitric acid at a temperature of 15 to 20 deg. C., the excess of acid is pressed out, and the material is passed through a 10 per cent solution of sodium bisulphate, and washed with water. Specification 136,568 is referred to. (Br. Pat. 144,204—1919. GILLET ET FILS, Lyons, France, Aug. 5, 1920.)

Lead and Silver Chlorides.—Sulphide ores and products containing silver, lead and zinc sulphides are partially chloridized, for instance by heating with enough zinc chloride to chloridize the silver and lead, and the product, from which the excess of zinc chloride may be removed by leaching with water acidified with hydrochloric acid, is then leached with a solvent such as cold brine containing ferric chloride and which may be saturated with lead chloride, so as to extract the silver alone, and the residue is then leached with hot brine for dissolving the lead chloride. (Br. Pat. 144,260—1919. AMALGAMATED ZINC (DE BAVAY'S), LTD., Melbourne, Aug. 5, 1920.)

Sodium Hydrate.—Caustic soda is obtained by emulsifying a soda solution with lime by means of a "turbo-mixer" having at least one turbine-wheel or centrifugally-acting blade-wheel. The reaction is effected in the cold, for instance in about fifteen minutes. (Br. Pat. 144,266—1919. SCHWEIZERISCHE SODAFABRIK ZURZACH, Argovie, Switzerland, Aug. 5, 1920.)

Hydrogenating Oils and Fats.—An apparatus for use in the hydrogenation of oils and fats comprises a vessel 1 jacketed for heating and provided internally with means for converting the mixture of oil and catalyst into a mist or rain, and externally with a pump 16 for withdrawing the oil from the lower part of the vessel and returning it to the upper part for the treatment with hydrogen to be repeated; the means for spraying the oil comprises a series of buckets 4 mounted on a rapidly-rotating vertical shaft 3 and provided on their peripheries with sockets in which brushes 9 with short flaring bristles are mounted, so that oil delivered into the buckets by disk-shaped plates or partitions 6 is by centrifugal force caused to travel along the interstices of the brushes and to be delivered into the atmosphere



of hydrogen within the vessel as a mist or rain. The shaft 3 is mounted in a steadying plate 11, and below this is a stirring device for the oil that collects, consisting of blades 12 carried by the shaft 3 and blades 13 fixed to the casing; and below this, also carried by the shaft, is an agitator 14 to prevent settling of the catalyst. Connections 17, 18 are provided for the supply of oil and hydrogen. Specification 1380—1915 is referred to. (Br. Pat. 144,478—1919. BLAIR, CAMPBELL & MCLEAN, D. A. BLAIR and J. L. FERGUSON, Glasgow, Aug. 11, 1920.)

Azo Dyes.—Azo dyes are prepared by coupling diazo compounds containing a sulphonic or carboxylic acid group in *o*-position with 5 : 5'-dioxy-2 : 2'-dinaphthylamine-7 : 7'-disulphonic acid. According to examples there are obtained: A monoazo dye from 4-chlor-2-aminobenzoic acid and the second component; a primary disazo dye from two molecules of anthranilic acid and the second component; a primary disazo dye from 4 : 5-dichloraniline-2-sulphonic acid, 4-chlor-2-aminobenzoic acid, and the second component; a primary disazo dye from anthranilic acid, 4-chlor-2-aminophenol, and the second component; a trisazo dye by diazotizing the monoazo dye from anthranilic acid and 3-amino-4-cresol methyl ether and coupling with the monoazo dye from

anthranilic acid and the second component; a primary disazo dye from 1-naphthylamine-2-sulphonic acid, 4-chlor-2-aminobenzoic acid, and the second component; a primary disazo dye from two molecules of 4-dimethylamino-1-amino-benzene-2-sulphonic acid and the second component. The products dye cotton red to blue shades fast to ironing and the dyeings may be aftertreated with copper sulphate. (Br. Pat. 144,310—1919. FARBENFABRIKEN VORM. F. BAYER & Co., Leverkusen, Germany, Aug. 5, 1920.)

Borneol.—Borneol is prepared by heating pinene with tetrachlorphthalic acid and hydrolyzing the resulting dibornyl ester. (Br. Pat. 144,604—1919. FABRIQUES DE PRODUITS, CHIMIQUES DE THANN ET DE MULHOUSE, Thann, France, Aug. 11, 1920.)

Freeing Anthracene From Carbazole.—Crude anthracene is freed from carbazole by boiling with caustic potash in a neutral solvent—e.g., naphtha—while distilling off the water formed. The potassium-carbazole formed precipitates and is removed and worked up to carbazole. (Br. Pat. 144,648—1919. See also 144,656—1919. KINZLEBERGER & Co., Prague, Aug. 11, 1920.)

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Sulphuric Acid Manufacture.—Another sulphuric acid plant design which shows the tendency away from the lead chamber process is that of KENNETH B. QUINAN of Somerset West, Cape Province, South Africa. Instead of passing through the customary lead chambers, the gases are forced upward through diaphragms over which a constant flow of sulphuric acid is maintained. Products of the gaseous phase reactions and heat of reaction are rapidly absorbed by the circulating acid. It is convenient to arrange the diaphragm devices in series or in series-parallel. (1,348,736; Aug. 3, 1920.)

Barium Peroxide.—Barium monoxide may be converted into peroxide by treatment in an air-tight ball mill with dry ozidizing gas at a pressure of 20 to 60 lb. per sq.in. The temperature range for uniform oxidation is from 400 to 600 deg. C. By the use of a revolving mill of the type referred to, dense as well as cellular or porous monoxide may be treated with equal facility. (1,349,417; HERMAN FLECK of Golden, Col., assignor to the Peroxide Specialty Co.; Aug. 10, 1920.)

Electrolytic Chlorine Cell.—An improved form of electrolytic cell for the decomposition of brine consists of a suitable tank, a rectangular box-shaped cathode having perforated active end, side and bottom walls, a diaphragm covering the inner faces of all of these walls, and a rectangular tubular anode. Certain advantages result from this construction. For example, practically the entire inner face of the cathode, including the bottom, sides and end walls, is electrically active, and the exterior faces of the cathode are wholly unsubmerged in any body of electrolyte. By providing a water-tight and gas-tight pressure joint between the cathode and the free-board section, it is possible to build up the column of electrolyte in the free-board section so as to secure the desired hydrostatic head as the diaphragm becomes more or less clogged with the impurities in the brine, thus insuring a longer diaphragm life than would otherwise be possible. (1,349,597; HERBERT I. ALLEN and KENT R. FOX of Portland, Maine, assignors to Electron Chemical Co.; Aug. 17, 1920.)

Carbon Disulphide.—A charge of coke is brought to a red heat in a tumbling barrel having a refractory lining. A current of sulphur dioxide is passed through the tumbler forming carbon disulphide according to the reactions:

$$3C + 2SO_2 = CS_2 + 2CO_2$$
$$5C + 2SO_2 = CS_2 + 4CO$$

As the action is endothermic, a small amount of air is admitted with the sulphur dioxide in order to maintain the proper temperature by the combustion of a part of the coke. Since the carbon disulphide vapor which escapes is mixed with CO and CO_2 it cannot be condensed by simply lowering the temperature but must be absorbed in a suitable solvent (such as certain vegetable oils) from which it can be recovered by distillation. (1,350,858; HERBERT H. DOW and CHARLES J. STROSACKER, of Midland, Mich., assignors to the Dow Chemical Co.; Aug. 24, 1920.)

Extracting Tar From Vapors.—The removal of tar from vapors resulting from the distillation of coal or wood is accomplished by bubbling the vapors first through tar and then through cresol or anthracene oil. In the case of wood distillation the process is outlined as follows by EMILE A. BARBET of Paris, France. After passing through the tar, the vapors are at a temperature of 115 to 130 deg. C. In bubbling through the cresol, only the tar will be dissolved since at this temperature the water vapor and acetic acid vapor are superheated and cannot be retained by the cresol. (1,351,363; Aug. 31, 1920.)

Sodium Hydroxide.—The reaction between disodium phosphate (Na_2HPO_4) and milk of lime is utilized by SAMUEL S. SADTLER of Springfield Township, Pa., for the preparation of sodium hydroxide.

$$2Na_2HPO_4 + 2Ca(OH)_2 = 4NaOH + Ca_2H_2(PO_4)_2$$
$$2Na_2HPO_4 + 3Ca(OH)_2 = 4NaOH + Ca_3(PO_4)_2 + 2H_2O$$

The sodium hydroxide solution is separated from the insoluble calcium phosphate. Disodium phosphate may be recovered by treating the dicalcium phosphate with sodium sulphate or the calcium phosphate with niter cake. (1,351,693; Aug. 31, 1920.)

Acid-Resistant Alloy.—Considerable interest was aroused by a note in CHEM. & MET. ENG., Nov. 12, 1919, p. 632, concerning a new Italian alloy, "biakmetal." According to the present specification, this alloy consists of:

	Range Per Cent	Typical Example Per Cent
Copper	35 to 44	40
Iron	1.5 to 4.75	3
Tungsten	3 to 6	3
Nickel	60.5 to 45.25	54

Alloys of such composition, in cast condition, have a tensile strength of about 55 kg. per sq.mm. and an elongation of about 20 per cent. They may be forged and rolled both cold and hot. After drawing, the tensile strength in some cases exceeds 100 kg. per sq. mm. The alloy is said to resist the action of acids as follows: Sulphuric acid, any strength at temperatures under 100 deg. C.; hydrochloric, acetic, citric and tannic acids, any strength at any temperature; cold nitric acid, up to 1.40 sp.gr. (1,351,811; ARRIGO TEDESCO, assignor to Societa Anonima Stabilimenti Biak, of Turin, Italy; Sept. 7, 1920.)

Ferromanganese.—The manufacture of 80 per cent ferromanganese in the blast furnace is made possible by using a blast enriched with oxygen. (1,354,490; Estate of JOSEPH E. JOHNSON, Jr.; Oct. 5, 1920.)

Current Events
in the Chemical and Metallurgical Industries

American Petroleum Institute's Annual Meeting

The American Petroleum Institute will hold its annual meeting in Washington, with headquarters at the New Willard Hotel, on Wednesday, Thursday and Friday, Nov. 17, 18 and 19, 1920. All the general sessions and group meetings will be held at this hotel, unless otherwise announced. Group meetings covering specific subjects such as Statistics, Transportation, Taxation, Research, etc., will be held in the forenoon of each day, followed by general sessions on the afternoons and evenings of the three days, with the exception of Friday evening, which will mark the Institute's annual banquet and the closing of the convention.

The general topic for consideration on the first day will be "The World's Petroleum Problem." Speakers of national and international renown will deliver addresses covering the relationship of America, Great Britain, Mexico and other oil-producing countries to the world's petroleum problem. The general topic for the second day is "The Production and Consumption Situation."

The topic for discussion at the general session Friday afternoon will be "The Future of the Oil Business." The program as outlined for the general sessions will represent the last word as to the world petroleum situation, the present-day status as to production and consumption, and a forecast as to the industry's future. Specific subjects such as transportation, taxation, statistics, research, improvements in methods, etc., will be discussed by experts in the group meetings. Throughout the three days' session the emphasis will be upon oil. Because of its national and international character, this meeting of the Institute will mark a distinct step in the industry's progress and development.

Remuneration for C.W.S. Consulting Chemists

Some difficulty is being experienced by the Chemical Warfare Service in finding a basis for the remuneration of the consulting chemists who are to be appointed. It is believed, however, that no legal or other difficulties will prevent the payment of a per diem salary, in addition to traveling expenses. General Fries is very anxious that authority be secured to pay traveling expenses, so that he will feel less hesitant in asking a chemist living at a distance to go to Washington. It is his intention to have a large number of consulting chemists attached to the service, so that the list may include specialists in a large number of subjects. As problems arise, he would like to be in a position to send for the chemist best qualified to handle each particular one. For instance, just at this time, in the study of the physiological effect of certain gases, it is highly desirable to have the assistance, for a very few days, of a chemist in a Western city. That particular chemist is thought to be best qualified to be of service in this specific juncture. It may be months before his actual presence in the laboratory again would be imperative. General Fries wants to be in a position to pay this man's traveling expenses and a per diem salary for the time he is absent from his office.

Metric System Advocated at Meeting of Rochester Engineering Society

Members and friends of the Rochester Engineering Society heard the affirmative side of the question of the national adoption of the metric system presented by Dr. W. N. Souder, of the Bureau of Standards, Washington, D. C., Friday evening, Oct. 8. At the outset Dr. Souder made clear the position of the Bureau of Standards by reading a telegram from Director Stratton, which read as follows: "The bureau believes an international decimal system of weights and measures very desirable. It has never advocated any particular method in bringing this about. We believe that the time, method and the extent of the change in any particular branch of manufacture should be settled only after a careful consideration of the question by representatives of that industry."

Dr. Souder's purpose was not to convert the engineers to the general adoption of the metric system, but to point out the drawbacks of the present English system and to show the need for a consistent standard of weights and measures. The strongest argument against the compulsory adoption of the metric system was the fact that the changing of the weight and measurement sizes would be costly. However, if in the end this resulted in a saving of time and convenience, the first expense would soon be absorbed. Dr. Souder's final plea was that "we ought to have some sort of a consistent standard of figuring."

Nominations for President of the American Chemical Society

At a meeting of the Council of the Pittsburgh Section of the American Chemical Society on Oct. 9, Dr. Raymond F. Bacon, Director of the Mellon Institute of Industrial Research of the University of Pittsburgh, was nominated for the presidency of the Society. It is understood that this nomination has received wide and cordial approval throughout the mid-continent sections.

Dr. Edgar F. Smith, provost emeritus of the University of Pennsylvania, has been proposed by the Philadelphia and Delaware sections for presidency of the Society. His nomination has received the indorsement of the New York Section. Dr. Smith served as president in 1898 and his executive accomplishments elicited the most favorable commendation.

Prof. E. C. Franklin was proposed by the Washington Chemical Society as nominee for president of the American Chemical Society for the coming year, as a result of the action taken at its last meeting, Oct. 14. At the same meeting the following four were suggested as nominees for positions as councillors-at-large of the society: George P. Adamson, James F. Norris, Arthur M. Comey, and A. C. Fieldner.

At this meeting of the section a report was given on the proceedings of the council at Chicago, and Dr. W. M. Clark spoke on "Application of Hydrogen Ion Concentration Measurements in Analytical and Biological Chemistry."

Division of Technology Discontinued

Effective Oct. 15 the work heretofore assigned to the division of technology, Prohibition Unit, Bureau of Internal Revenue will be subdivided and administered by two divisions known as the Permit Division and the Industrial Alcohol and Chemistry Division. The title "Division of Technology" is discontinued.

Dr. A. B. Adams, former head of the Division of Technology, is appointed head of the Permit Division. J. M. Doran, assistant head of the Division of Technology, is appointed head of the Industrial Alcohol and Chemical Division. The change is made necessary by the increase in the work devolving upon the Division of Technology. The Permit Division will examine and pass upon applications for the manufacture of alcoholic products; determine all non-beverage uses of intoxicating liquors and limitations of such uses; fix standards for manufactured articles containing alcohol; examine bonds; conduct trade investigations to determine whether products are bona fide and whether permitted articles are manufactured in accordance with approved formulas. The Industrial Alcohol and Chemical Division will have supervision of the construction and operation of industrial alcohol and denaturing plants and control of the work of the plant officers; develop uses of denatured alcohol by laboratory work and research; examine denatured alcohol samples; examine samples of toilet articles, flavoring extracts, etc., and report result of analysis to the Permit Division.

Contribution for Co-operative Research From General Electric Co.

The General Electric Co. has contributed $30,000 to extend the investigations of the Committee on Fatigue Phenomena of Metals, of the Division of Engineering of the National Research Council. Engineering Foundation Board about a year ago made a grant of $15,000 a year for a period of two years for the investigation of fatigue phenomena in carbon steels. Articles of agreement were drawn up among the National Research Council, Engineering Foundation and the University of Illinois, whereby the experimental work was to be done at the University of Illinois under the direct supervision of Prof. H. F. Moore.

The contribution of the General Electric Co. was made in order to extend the work to include 3 per cent and 3½ per cent nickel steel. This extension is to be considered part of the original program and no restriction is placed by the General Electric Co. on the publication of the results. Although the results of this work on nickel steels will be of immediate commercial value to the General Electric Co., they will also be of value to other manufacturers.

Quarters Sought for Chemists at Edgewood

The Chemical Warfare Service not only is having difficulty in obtaining civilian chemists at the salaries allowed by the Government, but is having trouble in keeping such chemists as are obtained, due to the absence of proper housing in the vicinity of the arsenal. General Fries has applied to the General Staff for permission to erect twenty-four five-room cottages. The General Staff is not inclined to give its permission, as it has not been the policy to supply quarters for civilians. General Fries states that it will be necessary to depart from the rule if chemists and technical men are to be induced to stay at Edgewood.

Merger of Pittsburgh Plate Glass Co., Columbia Chemical Co. and Patton-Pitcairn Proposed

To insure the full requirements of soda ash which the Pittsburgh Plate Glass Co. uses in large quantities in the manufacture of its products the company proposes to acquire the chemical plant and business of the Columbia Chemical Co. This latter company has a plant located at Barberton, Ohio, with a productive capacity of about 700 tons of heavy chemicals per day. Its principal products are soda ash and caustic soda, with lime fertilizer as its chief byproduct. The company also owns a fine limestone property near Zanesville which is being equipped and will be in operation in November.

Realizing the advisability and advantages in participating in the manufacturing and sale of kindred products such as window glass, art glass, paints, varnish and dry colors, the Pittsburgh Plate Glass Co. has also acquired controlling interest in the Patton-Pitcairn Co. and its subsidiaries, thereby securing a lasting commercial arrangement to participate in the production of these products. Consolidation arrangements have been approved unanimously by the boards of directors and it is expected that the plans will be ratified by the majority of stockholders in the near future.

Dye Bill to Be Pushed

Friends of the dyestuffs bill, which passed the House at the last session of Congress and now in amended form is at the head of the Senate calendar, have been busy during the recess of Congress securing pledges that this legislation will be pushed when Congress meets again in December.

On the other hand, it is recognized that the short session gives great advantage to such experienced opponents of the measure as are Senators Moses and Thomas. It was the Moses-Thomas opposition which prevented the bill coming to a vote at the last session. Since the appropriation bills and a vast amount of other legislation of first importance must be taken care of during the short session, there is a general disinclination to take up a matter which is certain to call forth protracted discussion. The opposition to the bill is nonpartisan. Senator Moses is a Republican and Senator Thomas is a Democrat. The administration favors dyestuffs legislation. Most of the Democratic members favor such measures as may be necessary to safeguard the domestic dye industry.

W. R. Crane Sent to Tuscaloosa

W. R. Crane has been selected as the superintendent for the new experiment station of the Bureau of Mines at Tuscaloosa, Ala. Mr. Crane has been chief engineer for the War Minerals Relief Commission for the past year.

Two non-metallic specialists are to be assigned to the Tuscaloosa station. One is to be engineer whose duties will be confined to the laboratory. The other will be a field and contact man.

New C.W.S. Examination

Thirty Army officers have announced their intention to take the examination, late this month, for commissions in the Chemical Warfare Service.

Examinations will be conducted in November at which young men from civilian life with some chemical training may qualify as Second Lieutenants.

Chemical Warfare Officers' Reserve Corps

Tentative instructions governing appointments in the Chemical Warfare Officers' Reserve Corps have been issued as follows:

Recent legislation has made the Chemical Warfare Service a permanent branch of the Army, and a Chemical Warfare Officers' Reserve Corps is now being organized as per regulations from the Adjutant General's Department. The regulations governing reserve officers in the Chemical Warfare Service will be similar to the regulations governing reserve officers in the Army at large.

In a general way appointments will be made in the section for which the officer applies or for which his records show him best suited. For this reason a number of the applications of officers who have applied for the Chemical Warfare Service in the past will automatically be referred to the Chemical Warfare Service Board. The Adjutant General has ruled that all officers now holding commissions in any section of the Officers' Reserve Corps and whose records bear notation that they are qualified and were appointed for duty in some other section, now authorized (such as the Chemical Warfare Service), will be transferred to such section with their present grade and date of commission. Accordingly, officers now holding commissions in Engineers, Quartermasters, etc., bearing the notation Chemical Warfare Section will automatically be acted on by the C.W.S. Board. Even though this be more or less automatic, it is considered advisable that each one resubmit an application through the Adjutant General, Washington, D. C., for the Chemical Warfare Service Reserve.

Pending the promulgation of regulations governing appointments in the Officers' Reserve Corps under the provisions of the act of June 4, 1920, the following tentative instructions governing appointments are published for the information and guidance of all concerned:

Who May Be Appointed

1. Persons who served as officers of the United States Army at any time between April 6, 1917, and June 30, 1919.
2. Former officers of the Regular Army.
3. Officers of the National Guard on June 4, 1920.
4. Reserve Officers' Training Corps graduates in accordance with Changes 6, S.R. No. 43, War Department, 1919.

Grades in Which Appointments May Be Made

1. Appointments will be made in the Chemical Warfare Service in all grades from Colonel to Second Lieutenant, inclusive.
2. A person eligible under these instructions may be appointed as a reserve officer in the highest grade which he held in the Army, or in any lower grade. National Guard officers found qualified will be commissioned in the same grade as they held in the National Guard on June 4, 1920.

Requisite Qualifications

Physical—(*a*) In the line of the Army, no defects disqualifying for hard field service; any minor defects to be waived. (*b*) In staff corps to have no defects disqualifying for particular kind of duty to be performed.

Professional—In general the records must show favorable recommendations, an average rating of at least 53, and suitability for appointment in the Reserve Corps.

Age—Appointees must be at the time of appointment between the ages of twenty-one and sixty years and no appointments in effect or hereafter made shall be terminated on account of age, but shall be permitted to continue in effect for statutory five years from date of appointment.

Citizenship—All appointees must be citizens of the United States or the Philippine Islands.

Miscellaneous

Warrant officers and enlisted men of the Regular Army and National Guard may hold commissions in the Officers' Reserve Corps and continue their status as enlisted men.

A reserve officer may hold commission in the National Guard without affecting his reserve commission.

Employees of the Federal Government may not hold a commission in the Officers' Reserve Corps without the consent of the head of the department in which employed.

The President may order a Reserve Corps officer to active duty with any of the military forces of the United States at any time, for any period, *but except in time of national emergency expressly declared by Congress* no reserve officer shall be employed on active duty for more than fifteen days in any one calendar year without his consent. Mileage at the prescribed rate and compensation at the rate for the corresponding grade in the Regular Army will be paid while on active duty. There is no provision for pay while on inactive service status. A reserve officer is not entitled by law to retirement or retired pay. Reserve officers must provide their own uniforms and all articles of clothing and equipment which would be required in the public service. These articles may be purchased from the Quartermaster's Department at any time by reserve officers on the inactive list. Sales of subsistence and stores are not authorized. Any reserve officer may hold a commission in the National Guard without thereby vacating his reserve commission. Reserve officers may submit resignations from their commissions at any time, but the acceptance of same is at the discretion of the President. Notices of change of permanent address should be sent to the Adjutant General of the Army.

Expedition to Gather Scientific Data in South America

Dr. Henry H. Rusby, dean of the School of Pharmacy of Columbia University, is to start with a party composed of an ichthyologist, an entomologist, a motion picture photographer and possibly another physician for an extended exploration tour of the eastern slope of the Andes Mountains and the basin of the Vaupéz, Negro, Amazon and Madeira Rivers in South America.

This expedition has been formed to gather important scientific data on the flora and fauna of the region, with particular reference to their economic application as well as for their purely scientific value. Dr. Rusby has been in Washington in conference with heads of the various departments of entomology, ichthyology and plant industry, who will collaborate with him in interpreting the results of the data obtained by his party. An attempt will be made to introduce into our own tropical regions—the Phillippine Islands—useful native tropical plants which may be discovered with the idea of increasing their usefulness. Dye, oil-producing food and medicinal plants will receive special attention both as to their sources of supply and their useful properties.

The problem of insects as carriers of disease and destroyers of plants will be carefully investigated in order to gather information to combat their ravages.

Dr. Rusby intends also to make a study of the various arrow poisons used by the natives of this region and thereby extend our limited knowledge of these toxic substances.

Personal

FREDERICK E. BREITHUT has accepted a position with the Calco Chemical Co., Bound Brook, N. J.

Colonel G. A. BURRELL has resigned his position as president of the Island Refining Corp. to take charge of refinery construction for the France-Canada Shipping Corp., 120 Broadway, New York City. He sailed for England on Oct. 23, to be gone three months.

C. C. COOPER, Editor *Mill Supplies*, Chicago; C. J. STARK, Editor *Iron Trade Review*, Cleveland, and RAY W. SHERMAN, of Class Journal Co., New York City, were elected respectively president, vice-president and secretary-treasurer of the National Conference of Business Paper Editors at the annual meeting in the Hotel Astor, New York, on Oct. 20 and 21.

Dr. W. D. ENGLE, professor of chemistry in the University of Denver, has been appointed acting chancellor of the institution on account of the illness of Chancellor H. A. Buchtel, who was recently stricken with paralysis.

Dr. COLIN G. FINK, of New York, recently addressed the Rochester Section of the American Chemical Society on "Modern Developments in Metallurgical Research."

H. D. FOSTER will work at the Bureau of Standards as research associate on problems connected with hollow clay tile. He has been appointed to this work by the Hollow Clay Tile Manufacturers' Association, under the form of co-operative agreement which is being used by the Bureau of Standards to carry on work of this sort.

A. J. GAILEY has left the W. L. Cummings Chemical Co., Lansdowne, Pa., to accept the position of research chemical engineer for the Electrometallurgical Co., Niagara Falls, N. Y.

Major E. HOLMES has recently been appointed manager of the chemistry department of the National Lime Association.

S. Z. KRUMM, graduate of the Colorado School of Mines and until recently instructor of metallurgy in that institution, has been appointed instructor in metallurgy and ore treatment at the Case School of Applied Science.

WILLIAM RUSSELL, the Dorr Co.'s London manager, is now in the United States on his regular annual visit to study the latest practices in the chemical and metallurgical fields.

RICHARD SHELDRICK has resigned as secretary, director and sales manager of the Kalbfleisch Corp., after a connection of fifteen years, and is now associated with D. A. Kimadi & Co., Inc., New York, as vice-president.

Captain WILKINSON STARK, late of the Army Ordnance Department, has joined the engineering staff of the John Johnson Co. Captain Stark was released by du Pont at the beginning of the war to supervise the design, installation and operation of the Army's caustic recovery and cotton purification, bleaching and drying divisions at Explosives Plant "C," Nitro, W. Va. Prior to the du Pont connection, where Captain Stark was in charge of similar work at the company's Hopewell Powder Works, he was for six years Assistant State Chemist of Missouri.

Dr. R. K. STRONG has recently been appointed head of the department of chemistry at Reed College, Portland, Ore., where special attention will be given to the chemical industries of the region, among them paper pulp, which promises to be the leading industry. Dr. Strong has made a careful study of the local situation during the last three years.

G. D. VAN ARSDALE will open an office in Los Angeles as consulting engineer, specializing in hydrometallurgy, flotation, etc. Mr. VAN ARSDALE has been for a number of years consulting chemist to the Phelps, Dodge Corp., with headquarters in New York, and is still retained by that corporation in the same capacity.

Obituary

CHARLES ERNEST ACKER, manufacturing chemist, died at his home, 80 Main St., Ossining, N. Y., on Oct. 18, in his fifty-second year. He built the plant of the Acker Process Co. at Niagara Falls, and was known as the originator of processes for the manufacture of tetrachloride of tin and carbon tetrachloride, and was the first to manufacture carbon tetrachloride in this country. Mr. Acker held about fifty patents in this and foreign countries for inventions relating to the chemical and electrochemical industries. Mr. Acker was graduated from Wabash College and Cornell University, and for several years was an electrical engineer in Chicago. He was a member of the American Institute of Electrical Engineers, Chemists' Club of New York City, the Society of Chemical Industry, Society of Arts (London), the Faraday Society (London) and other organizations.

JOSEPH J. MILLER, president of the Miller Chemical Engine Co., manufacturer of hand-operated fire extinguishers, died Oct. 12 at his home in Chicago, Ill., after an illness of seven months. Mr. Miller was born in Elizabeth, N. J., Sept. 16, 1848. He had been head of this firm in Chicago for many years.

ELISHA S. WILLIAMS, vice-president of the United States Rubber Co., New York, died on Oct. 8. Mr. Williams was born in Malden, Mass., in 1873, and was educated in the Malden public schools, taking a business course in the Malden high school. He then entered the employ of the Revere Rubber Co., of which he later became president. On Jan. 1, 1910, the Revere Rubber Co. was purchased by the United States Rubber Co. and he was then elected president of the Rubber Goods Mfg. Co. He was largely instrumental in the consolidation of the tire business of the Rubber Goods Mfg. Co.'s subsidiaries by forming the United States Tire Co. in 1911, of which he was the president until 1915. In 1915 he was elected vice-president of the United States Rubber Co., in charge of the mechanical goods business. He was also a director of the United States Rubber Co., a member of the operating council and president of several subsidiary companies.

Current Market Reports

The Iron and Steel Market

Pittsburgh, Oct. 22, 1920.

Cancellations, suspensions and postponements in the matter of steel contracts and deliveries continue, but are of diminished volume. Results of this movement are now plainly apparent in decreased operation at not a few of the steel mills. Naturally the mills affected are those that were charging the highest prices, and those that were charging the highest prices are those that had the smallest volume of business on books, for otherwise they would have been unable to promise the early deliveries for which particularly high prices were obtainable. Thus the mills that have the largest volume of cancellations and postponements are the ones that are least able to stand the operation, and accordingly their operations are promptly affected.

The fact should be noted, as having an important bearing upon the present steel market situation and the prospects for price changes, that the relative position of mills is quite different from that which usually obtains at a time when demand has greatly declined, but there remains, in the aggregate, a large volume of business on books. Ordinarily the mills are all sold for somewhat the same time ahead, since in an ordinary market prices are uniform among sellers. Since the first of the year there have been wide divergences in prices of different sellers, there having been for much of the time at least three markets. The

result is that some mills that were only recently the highest priced sellers are now the lowest priced among the independents. Again, the mills that are well sold ahead are disposed to maintain their prices and curtail their production to such extent as is necessary, while they fill the contract tonnage. Other mills are disposed to cut prices to the point at which they can book new business, for there is always a little business to be had, even in such a dull market as now prevails. No consistent and uniform policy, therefore, is likely to be adopted.

Output of Steel Decreased

Production of steel has now been curtailed by so many mills that the rate of output is materially below that of August and September. Output of ingots as a whole in October, which will be reported upon in due course, will probably show a rate of something like 41,000,000 tons per annum, against a rate of about 42,700,000 tons in August and September. The Steel Corporation's rate of output has, if anything, increased somewhat.

A particularly interesting event of the week was that on Monday the Pittsburgh Crucible Steel Co. began quoting merchant steel bars at 2.35c., which is the Steel Corporation price. Previously the company had been confining its attention to the prompt market, in which it was able to secure very high prices. The action became known almost immediately to the other producers, who, however, showed no disposition to follow suit, but continued to quote from 3c. to 3.25c. Some of them have large contract tonnages, which would be more or less jeopardized if they reduced their prices, and the theory is that the company quoting 2.35c. will soon secure as much business as it requires, whereupon the price can be withdrawn.

Automobile and parts makers assert that they have secured some substantial price readjustments on steel contracts, but more adjustments are being sought. These trades are offering no new business of consequence as in the main they are fully bought, or more than bought, to the end of the year. Already they state that they expect to secure still lower prices when the time comes for them to place contracts for the first half of the new year.

Freight Car Buying

The lightness of freight car buying, commonly attributed to inability of the railroads to finance loans upon suitable terms, should be better understood. In actual fact there is what amounts to a deadlock in the matter of prices. For a standard 50-ton open-top car the price at present is about $3,400, while the railroads feel they ought to be able to buy at about $2,700, for even that would be fully three times the lowest price before the war, and more than double the average price paid for all such cars that have been bought since the steel car came into vogue. In but very small part the extra price rests upon high prices for steel, and the car-building companies are not charged with endeavoring to make too large profits per car, but it is positively asserted that prices for the various trimmings and appurtenances which car builders buy as an assembling proposition are altogether too high. The Steel Corporation itself needs a number of cars, but is indisposed to encourage the present situation by buying cars. Certainly the corporation can have no objection to such part of the present price of freight cars as is based on the cost of steel, since the corporation would naturally furnish steel itself for any cars it should buy.

Rumors persist that the United States Steel Corporation will advance most or all of its finished steel prices by an average of say $3 or $4 a ton, the advance to be predicated upon increased costs due to the freight rate advances of Aug. 26. It seems certain that the corporation has formulated no definite policy in this matter, but undoubtedly the matter is being given careful consideration. Such slight advances might encourage the independents to drop, and thus the market would be equalized, something the independents should desire and should be willing to help bring about. Possibly the corporation will readjust its prices, instead of making a horizontal advance, so as to correct inequalities that may now exist.

There have been no further developments in basic iron since the decline in the quotable market to $42 valley reported a week ago. There has been no demand that would bring about any new condition. Foundry pig iron has been quiescent. Occasional small lots are sought by consumers from their regular sources of supply, and these have simply been sold at the $47 valley price that the furnaces recently came to the conclusion could be regarded as "the market" until competition should effect a further reduction. In bessemer iron there is to be recorded a decline of $1.50 a ton in the quotable market, a $47 valley price becoming quotable by a large producing interest formally offering a lot of 1,000 tons at this figure. A sale of a carload at $47 is reported.

As noted in last report, the declines in pig iron occur while coke is still at altogether irrational levels. Pig iron cannot find a secure and stable level as long as the cost of coke is so greatly in doubt. Connellsville furnace coke for spot shipment has declined $2 in the past week, from $17 to $15 per net ton at ovens, but even $15 is ten times the price in May, 1915. Until coal experiences the inevitable slump coke cannot get on a really proper level, as the coal used in making coke has too high a market value. The decline that has occurred in coke was brought about partly by the improved production of the past two or three weeks, but chiefly by the altered policy of a number of merchant furnacemen who, being in receipt of numerous requests for curtailment in shipment of pig iron against contracts, have concluded to bank or blow out in the near future, and to get ready for the event they either buy less spot coke in the open market or instruct coke operators to decrease shipments on contract. In some instances there are piles of coke at furnaces that are to be consumed before banking or blowing out.

The Chemical and Allied Industrial Markets

New York, Oct. 23, 1920.

The past week has shown no tendency toward improvement in the chemical market, in fact prices are uniformly descending, owing to the long deferred activity on the part of buying interests. Supplies are being accumulated on all sides and in practically every case stocks are in excess of the demand. On the other hand producers are confronted with the cost of production—which is steady, if not increasing—and have for the most part firmly maintained prices at the recent levels.

Heavy Chemicals

Soda ash is firm at last week's figures of $2.50 per cwt. for light ash and $3 per cwt. for dense. Numerous rumors are abroad concerning producers' 1921 contract price, but so far nothing definite has been announced. The prophetic whisperings differ in matter of 10c. per cwt., $1.85 being the favored mark. Very little business is being done in *aqua ammonia*, which is still quoted around 10½@11c. in carboys. Although prices as low as 12c. per lb. are heard for *carbon tetrachloride*, they are few and are concessions being made by second hands, but so far producers have firmly maintained the former 13@13½c. level. Concessions are also being made on *acetic acid*, glacial, 99½ per cent, and some business was transacted at $11@$11.50 per cwt., which is $5 under the prices quoted by producers. Both *sodium nitrate* and *nitrite* dropped during the period, the former being now listed at $3 compared with $3.75@$4 of the previous week, while the latter is down to 11@12c. in car lots against 12@14c., the prevailing price for some time. The prices of *tin* products have remained about the same with the usual routine business unaffected, *bichloride*, 50 per cent, being listed at 13¾c. per lb. and *oxide* at 55@60c. per lb. by producers.

Coal-Tar Products

Recent reports of this market have been consistently alike in summing up the business conditions. Dullness—implying absolute inactivity—has been the keynote for some time, and although prices on all items have been reduced to meet the slackness, buyers are firm in holding out for still lower levels; despite the fact that there have been no changes in the list, the trade is on the decline. The crudes on the

other hand show a healthy firmness as the supply is a trifle short of demand.

Naval Stores

It seems that the rock bottom has been reached in *rosin* prices, which is $12.45 for all grades. The local demand has been fairly heavy when compared to the recent dullness, but foreign inquiry is practically nil and as a result considerable supplies are being accumulated in Savannah. *Turpentine* also declined during the early part of the week, but a slight flurry toward the end brought the quotation back to $1.25 per gal.

Oils

Despite the low prices prevailing on *linseed* there has been no move on the part of buyers to take advantage of the present levels. Nominal quotations of $1.07 have been received but the small amount of business that has been transacted is nearer the $1 mark. *Cottonseed* remains at the 12@13c. price, and although there was a slight weakness exhibited in the early part of the period the closing market was firm. *Chinawood* dropped off 1c. and *coconut*, affected by *soya bean*, fell off slightly from 16½c. to 15½c. per lb.

The Baltimore Market

Baltimore, Md., Oct. 20, 1920.

The general waiting attitude on the part of buyers of fertilizer raw materials prevails on the local market. Offerings of all kinds are in evidence, but buyers are reluctant in expressing interest in them. It has been persistently rumored among the local trade that prices for spring on mixed goods are as follows: $5.25 per unit of ammonia; 80c. per unit available phosphoric acid; $2.50 per unit of potash. This price schedule has not been officially confirmed, but it seems to be the general belief that the finally accepted schedule will not be far out of line.

Acid Phosphate

The market continues nominal at about $18 per ton, basis 16 per cent, bulk, run of pile. Reports have been received, however, of sales as low as $17. High-grade raw rock at the mines is being quoted nominally at about $10 per ton.

Nitrate of Soda

Chilean nitrate continues to come into this port on contracts, and relatively large tonnages are being placed in storage. Resales of spot lots have been made at $3.15 per cwt. and the importers are quoting around $3.20 per cwt. ex-vessel Baltimore and other Atlantic ports of arrival.

Sulphate of Ammonia

There was reported a resale of sulphate this week at $4.50 per cwt., basis 25 per cent. This makes a drop of 25c. per cwt. since last letter. Large stocks of this material are not in evidence.

Potash

A price of $1.60 per unit of K_2O has been the lowest offering noted for kainit and manure salts; in fact, very little of this grade of potash is changing hands at any price at this time. Nebraska producers have not yet offered their forward deliveries on the market, as most of them have contracted for their output up to November and in some cases up to the first of the year. Muriate of potash is being nominally quoted at $2.20, although spot parcels are held 10@20c. higher. The lowest offering noted was a lot of foreign muriate at $1.90 per unit c.i.f., North Atlantic port for November.

Fish Scrap

Machine dried unground menhaden fish scrap is available at this writing at $6 per unit of ammonia and 10c. per unit b.p.l. delivered Baltimore. Forward deliveries are being held at $6.25 and 10c., and sales in a small way have been effected at this figure. The fishing on Chesapeake Bay has been very poor for the past week; in fact, the factories are now contemplating "cutting out" the latter part of this month or the early part of next, unless fishing improves materially within the next few days.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	.....	$0.65 – $0.75
Acetone	lb.	$0.19 –$0.20	.21 – .22
Acid, acetic, 28 per cent	cwt.	3.50 – 3.75	4.00 – 4.50
Acetic, 56 per cent	cwt.	7.50 – 8.00	8.50 – 9.50
Acetic, glacial, 99½ per cent. carboy	cwt.	14.00 –16.00	16.25 – .....
Boric, crystals	lb.	.15½– .16	.16½– .19
Boric, powder	lb.	.15½– .16½	.17 – .20
Citric	lb.	.70 – .75	.76 – .77
Hydrochloric (nominal)	cwt.	2.00 – 2.50	2.75 – 3.00
Hydrofluoric, 52 per cent (nominal)	lb.	.15 – .16	.16½– .18
Lactic, 44 per cent tech.	lb.	.10 – .11½	.12 – .16
Lactic, 22 per cent tech.	lb.	.04½– .05½	.06 – .07
Molybdic, C. P.	lb.	4.00 – 4.50	4.50 – 5.00
Muriatic, 20 deg. (see hydrochloric)		.....	.....
Nitric, 40 deg.	lb.	.07 – .07½	.08 – .08½
Nitric, 42 deg.	lb.	.07½– .08	.08½– .09½
Oxalic, crystals	lb.	.35 – .36	.38 – .40
Phosphoric, Ortho, 50 per cent solution	lb.	.22 – .23	.24 – .25
Picric	lb.	.28 – .35	.40 – .50
Pyrogallic, resublimed	lb.	2.30 – 2.55	2.60 – 2.65
Sulphuric, 60 deg., tank cars	ton	12.00 –16.00	.....
Sulphuric, 60 deg., drums	ton	.....	.....
Sulphuric, 66 deg., tank cars	ton	16.00 –17.00	18.00 – 20.00
Sulphuric, 66 deg., drums	ton	26.00 –28.00	.....
Sulphuric, 66 deg., carboys	ton	.....	.....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	27.00 –30.00	37.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) drums	ton	28.00 –30.00	38.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	32.00 –35.00	40.00 – .....
Tannic, U. S. P.	lb.	1.45 – 1.50	1.55 – 1.65
Tannic (tech.)	lb.	.60 – .70	.80 – .90
Tartaric, crystals	lb.	.70 – .73	.74 – .77
Tungstic, per lb. of WO	lb.	.....	1.20 – 1.40
Alcohol, Ethyl (nominal)	gal.	5.50 – 5.75	.....
Alcohol, Methyl (see methanol)		.....	.....
Alcohol, denatured, 188 proof (nominal)	gal.	.....	1.12 – 1.15
Alcohol, denatured, 190 proof (nominal)	gal.	.....	1.05 – 1.10
Alum, ammonia lump	lb.	.04½– .05½	.05½– .06
Alum, potash lump	lb.	.07 – .08½	.09 – .09½
Alum, chrome lump	lb.	.14½– .15	.16 – .17
Aluminum sulphate, commercial	lb.	.02½– .03	.....
Aluminum sulphate, iron free	lb.	.04½– .05	.....
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.10½– .10¾	.11 – .12
Ammonia, anhydrous, cylinders (100-150 lb.)	lb.	.35 – .35½	.36 – .38
Ammonium carbonate, powder	lb.	.15 – .16	.16½– .17
Ammonium chloride, granular (white salammoniac) (nominal)	lb.	.13 – .14	.....
Ammonium chloride, granular (gray salammoniac)	lb.	.12 – .13	.13½– .14½
Ammonium nitrate	lb.	..... – .10	.11 – .14
Ammonium sulphate	lb.	.07 – .07½	.08½– .....
Amylacetate	gal.	.....	5.00 – 5.25
Amylacetate tech.	gal.	.....	4.75 – 5.25
Arsenic, oxide, lumps (white arsenic)	lb.	.13 – .14	.15 – .16
Arsenic, sulphide, powdered (red arsenic)	lb.	.16 – .17	.18 – .19
Barium chloride	ton	120.00–130.00	.....
Barium dioxide (peroxide)	lb.	.24 – .25	.26 – .27
Barium nitrate	lb.	.12 – .12½	.13 – .13½
Barium sulphate (precip.) (blanc fixe)	lb.	.04½– .05	.05½– .06
Bleaching powder (see calcium hypochlorite)		.....	.....
Blue vitriol (see copper sulphate)		.....	.....
Borax (see sodium borate)		.....	.....
Brimstone (see sulphur, roll)		.....	.....
Bromine	lb.	.70 – .80	.85 – .90
Calcium acetate	cwt.	3.50 – 3.55	.....
Calcium carbide	lb.	.04½– .04½	.04¾– .05½
Calcium chloride, fused, lump	ton	33.00 –34.00	35.00 – 45.00
Calcium chloride, granulated	lb	.02 – .02½	.03 – .03½
Calcium hypochlorite(bleaching powder)	cwt.	7.25 – 7.50	8.00 – 8.50
Calcium peroxide	lb.	.....	1.50 – 1.70
Calcium phosphate, monobasic	lb.	.....	.75 – .80
Calcium sulphate, pure	lb.	.....	.25 – .30
Carbon bisulphide	lb.	.08 – .09	.10 – .11
Carbon tetrachloride, drums	lb.	.13 – .14	.16 – .17
Carbonyl chloride (phosgene)	lb.	.....	1.25 – 1.50
Caustic potash (see potassium hydroxide)		.....	.....
Caustic soda (see sodium hydroxide)		.....	.....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.09 – .09½	.10 – .10½
Chloroform	lb.	.40 – .43	.44 – .47
Cobalt oxide	lb.	.....	2.00 – 2.05
Copperas (see iron sulphate)		.....	.....
Copper carbonate, green precipitate	lb.	.27 – .28	.29 – .31
Copper cyanide	lb.	.....	.65 – .70
Copper sulphate, crystals	lb.	.08 – .09	.09 – .09½
Cream of tartar (see potassium bitartrate)		.....	.....
Epsom salt (see magnesium sulphate)		.....	.....
Ethyl Acetate Com. 85%	gal.	.....	1.05 – 1.10
Ethy Acetate pure (acetic ether 98% to 100%)		.....	.....
Formaldehyde, 40 per cent (nominal)	lb.	.40 – .45	.....
Fusel oil, ref.	gal.	.....	5.25 – 6.00
Fusel oil, crude (nominal)	gal.	.....	.....
Glauber's salt (see sodium sulphate)		.....	.....
Glycerine, C. P. drums extra	lb.	.....	.26½– .28½
Iodine, resublimed	lb.	4.30 – 4.35	4.40 – 4.45
Iron oxide, red	lb.	.....	.03 – .20
Iron sulphate (copperas)	cwt.	2.00 – 2.25	2.35 – 2.75
Lead acetate, normal	lb.	.....	13½– .16
Lead arsenate (paste)	lb.	.11 – .12	.13 – .17
Lead nitrate, crystals	lb.	.....	.90 – 1.00
Litharge	lb.	.14 – .15	.15½– .16
Lithium carbonate	lb.	.....	1.50 – .....
Magnesium carbonate, technical	lb.	.12½– .13½	.14 – .15
Magnesium sulphate, U. S. P.	100 lb.	3.00 – 3.25	.....
Magnesium sulphate, commercial	100 lb.	.....	3.50 – 3.60
Methanol, 95%	gal.	.....	2.70 – 3.00
Methanol, pure	gal.	.....	3.40 – 3.60
Nickel salt, double	lb.	.....	.14 – .16
Nickel salt, single	lb.	.....	.13 – .14
Phosgene (see carbonyl chloride)		.....	.....
Phosphorus, red	lb.	.50 – .55	.60 – .65
Phosphorus, yellow	lb.	.....	.35 – .37
Potassium bichromate	lb.	.34 – .36	.39 – .40

		Carlots	Less Carlots
Potassium bitartrate (cream of Tartar)	lb.	$0.48 – $0.56	$0.57 – $0.58
Potassium bromide, granular	lb.	–	.63 – .65
Potassium carbonate, U. S. P.	lb.	.50 – .55	.56 – .60
Potassium carbonate, crude	lb.	.20 – .21	.23 – .25
Potassium chlorate, crystals	lb.	.18 – .18½	.19 – .20
Potassium hydroxide (caustic potash)	lb.	.27 – .28	.29 – .33
Potassium iodide	lb.	–	3.20 – 3.30
Potassium nitrate	lb.	.17 – .17½	.19 – .21
Potassium permanganate	lb.	.63 – .68	.70 – .75
Potassium prussiate, red	lb.	.85 – .95	1.00 – 1.05
Potassium prussiate, yellow	lb.	.32 – .36	.35 – .40
Potassium sulphate (powdered)	ton	$240.00 – 255.00	–
Rochelle salts (see sodium potas. tartrate)		–	–
Salammoniac (see ammonium chloride)		–	–
Sal soda (see sodium carbonate)		–	–
Salt cake	ton	–	48.00 – 50.00
Silver cyanide (nominal)	oz.	–	1.25 –
Silver nitrate (nominal)	oz.	–	.60 – .62
Soda ash, light	100 lb.	–	2.25 – 2.50
Soda ash, dense	100 lb.	–	3.25 – 3.50
Sodium acetate, U.S.P., granular	lb.	.25 – .26	.27 – .28
Sodium bicarbonate	100 lb.	2.50 – 2.75	2.85 – 3.00
Sodium bichromate	lb.	.22 – .24	.26 – .27
Sodium bisulphate (nitre cake)	ton	7.00 – 8.00	9.00 – 11.00
Sodium bisulphite Powered, U.S.P.	lb.	.08½	.10 – .11
Sodium borate (borax)	lb.	.09½ – .10	.11 – .12
Sodium carbonate (sal soda)	100 lb.	2.00 – 2.10	2.15 – 2.25
Sodium chlorate	lb.	.14½ – .15	.15½ – .16½
Sodium cyanide, 96-98 per cent	lb.	.25 – .30	.32 – .35
Sodium fluoride	lb.	.18 –	.19 – .20
Sodium hydroxide (caustic soda)	100 lb.	4.25 – 4.50	–
Sodium hyposulphite	lb.	–	.03 – .04
Sodium molybdate	lb.	2.50 –	3.25 –
Sodium nitrate	100 lb.	3.00 –	3.25 –
Sodium nitrite	lb.	.11 – .12	.13 – .14
Sodium peroxide, powdered	lb.	.32 – .35	.35 – .40
Sodium phosphate, dibasic	lb.	.03½ – .04½	.04½ – .05
Sodium potassium tartrate (Rochelle salts)	lb.	–	.37 – .38
Sodium prussiate, yellow	lb.	.25 – .27	.31 – .32
Sodium silicate, solution (40 deg.)	lb.	.01½ – .01½	.02 – .02½
Sodium silicate, solution (60 deg.)	lb.	.02½ – .03	.04 – .05
Sodium sulphate, crystals (Glauber's salt)	cwt.	2.15 – 2.50	2.60 – 2.75
Sodium sulphide, crystal, 60-62 per cent (conc)	lb.	.09½ – .10	.10½ – .11
Sodium sulphite, crystals	lb.	.04 – 0.4½	.04½ – .05
Strontium nitrate, powdered	lb.	.15 – .18½	.19 – .20
Sulphur chloride red	lb.	.08 – .09	.10 – .10½
Sulphur, crude	ton	16.00 – 20.00	–
Sulphur dioxide, liquid, cylinders	lb.	.09 –	.10 – .12
Sulphur (sublimed), flour	100 lb.	–	3.70 – 4.35
Sulphur, roll (brimstone)	100 lb.	–	3.40 – 3.90
Tin bichloride, 50 per cent	lb.	.13½ – .14	–
Tin oxide	lb.	–	.55 – .60
Zinc carbonate, precipitate	lb.	.16 – .18	.19 – .20
Zinc chloride, gran.	lb.	.13 – .13½	.13½ – .17
Zinc cyanide	lb.	.45 – .49	.50 – .60
Zinc dust	lb.	.12 – .13	.13 – .14
Zinc oxide, U. S. P.	lb.	.17 – .25	–
Zinc sulphate	lb.	.03½ – .03¾	.04 – .06

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.25 —	$1.35
Alpha-naphthol, refined	lb.	1.50 —	1.60
Alpha-naphthylamine	lb.	.45 —	.50
Aniline oil, drums extra	lb.	.28 —	.33
Aniline salts	lb.	.33 —	.36
Anthracene, 80% in drums (100 lb.)	lb.	.90 —	1.00
Benzaldehyde (f.f.c.)	lb.	2.00 —	2.10
Benzidine, base	lb.	1.35 —	1.40
Benzidine sulphate	lb.	1.15 —	1.25
Benzoic acid, U.S.P.	lb.	.85 —	.90
Benzoate of soda, U.S.P.	lb.	.80 —	.90
Benzene, pure, water-white, in drums (100 gal.)	gal.	.35 —	.40½
Benzene, 90%, in drums (100 gal.)	gal.	.33 —	.38½
Benzyl chloride, 95-97%, refined	lb.	.35 —	.40
Benzyl chloride, tech.	lb.	.25 —	.35
Beta-naphthol benzoate (nominal)	lb.	3.50 —	4.00
Beta-naphthol, sublimed (nominal)	lb.	.90 —	.95
Beta-naphthol, tech (nominal)	lb.	.60 —	.70
Beta-naphthylamine, sublimed	lb.	2.25 —	2.40
Cresol, U. S. P., in drums (100 lb.)	lb.	.18 —	.19
Ortho-cresol, in drums (100 lb.)	lb.	.23 —	.25
Cresylic acid, 97-99%, straw color, in drums	gal.	1.10 —	1.15
Cresylic acid, 95-97%, dark, in drums	gal.	1.05 —	1.10
Cresylic acid, 50%, first quality, drums	gal.	.65 —	.75
Dichlorbenzene	lb.	.07 —	.10
Diethylaniline	lb.	1.50 —	1.60
Dimethylaniline	lb.	.90 —	1.00
Dinitrobenzene	lb.	.30 —	.37
Dinitroclorbenzene	lb.	.32 —	.35
Dinitronaphthalene	lb.	.45 —	.55
Dinitrophenol	lb.	.40 —	.45
Dinitrotoluene	lb.	.38 —	.40
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38 —	.40
Diphenylamine (nominal)	lb.	.80 —	.85
H-acid (nominal)	lb.	1.75 —	1.85
Meta-phenylenediamine	lb.	1.25 —	1.30
Monochlorbenzene	lb.	.18 —	.20
Monoethylaniline	lb.	2.00 —	2.40
Naphthalene crushed, in bbls. (250 lb.)	lb.	.12 —	.14
Naphthalene, flake	lb.	.10½ —	.11
Naphthalene, balls	lb.	.12½ —	.13
Naphthionic acid, crude	lb.	.75 —	.85
Nitrobenzene	lb.	.14 —	.19
Nitro-naphthalene	lb.	.40 —	.50
Nitro-toluene	lb.	.18 —	.25
Ortho-amidophenol	lb.	3.25 —	4.25
Ortho-dichlor-benzene	lb.	.15 —	.20
Ortho-nitro-phenol	lb.	.80 —	.85
Ortho-nitro-toluene	lb.	.25 —	.40
Ortho-toluidine	lb.	.35 —	.38
Para-amidophenol, base	lb.	2.50 —	3.00
Para-amidophenol, HCl	lb.	2.50 —	3.00
Para-dichlorbenzene	lb.	.08 —	.12
Paranitroaniline	lb.	1.10 —	1.15
Para-nitrotoluene	lb.	1.25 —	1.40
Para-phenylenediamine	lb.	2.50 —	2.65
Para-toluidine	lb.	2.00 —	2.25
Phthalic anhydride	lb.	.60 —	.70
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.12 —	.20
Pyridine	gal.	2.00 —	3.50
Resorcinol, technical	lb.	4.25 —	4.50
Resorcinol, pure	lb.	6.25 —	6.75
Salicylic acid, tech., in bbls. (110 lb.)	lb.	.45 —	.50
Salicylic acid, U. S. P.	lb.	.45 —	.50
Salol	lb.	.85 —	.95
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.30 —	.35
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.20 —	.26
Sulphanilic acid, crude	lb.	.32 —	.35
Tolidine	lb.	1.70 —	2.50
Toluidine, mixed	lb.	.45 —	.55
Toluene, in tank cars	gal.	.35 —	–
Toluene, in drums	gal.	.38½ —	.40
Xylidines, drums, 100 gal.	lb.	.50 —	.65
Xylene, pure, in drums	gal.	.47½ —	.50
Xylene, pure, in tank cars	gal.	.45 —	–
Xylene, commercial, in drums, 100 gal.	gal.	.32½ —	.35
Xylene, commercial, in tank cars	gal.	.30 —	–

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.33 —	$0.38
Beeswax, refined, light	lb.	.34 —	.37
Beeswax, white pure	lb.	.60 —	.65
Carnauba, No. 1 (nominal)	lb.	.90 —	.95
Carnauba, No. 2, regular (nominal)	lb.	.85 —	.86
Carnauba, No. 3, North Country	lb.	.35 —	.36
Japan	lb.	.18 —	.20
Montan, crude	lb.	.14 —	.15
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.09 —	.09½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.09¾ —	.10
Paraffine waxes, refined, 118-120 m.p.	lb.	.11 —	.11½
Paraffine waxes, refined, 125 m.p.	lb.	.12¾ —	–
Paraffine waxes, refined, 128-130 m.p.	lb.	.13 —	.15
Paraffine waxes, refined, 133-135 m.p.	lb.	.16 —	.17
Paraffine waxes, refined, 135-137 m.p.	lb.	.17½ —	.18
Stearic acid, single pressed	lb.	.20 —	.21
Stearic acid, double pressed	lb.	.22 —	.23
Stearic acid, triple pressed	lb.	.24 —	.25

NOTE—Paraffine waxes very scarce.

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr., 0.930-0.940	gal.	$1.50
Pine oil, pure, dest. dist.	gal.	1.50
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.48
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.35
Pine tar oil, double ref., sp. gr. 0.965-0.990	gal.	.85
Pine tar, ref., thin, sp. gr., 1.080-1.960	gal.	.36
Turpentine, crude, sp. gr., 0.900-0.970	gal.	1.75
Hardwood oil, f.o.b. Mich., sp. gr., 0.960-0.990	gal.	.35
Pinewood creosote, ref.	gal.	.52

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	$12.45 —	–
Rosin E-I	280 lb.	12.45 —	–
Rosin K-N	280 lb.	12.45 —	–
Rosin W. G.-W. W.	280 lb.	12.45 —	–
Wood rosin, bbl.	280 lb.	12.00 —	–
Spirits of turpentine	gal.	1.25 —	–
Wood turpentine, steam dist.	gal.	1.22 —	–
Wood turpentine, dest. dist.	gal.	1.18 —	–
Pine tar pitch, bbl.	200 lb.	–	8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	14.50 —	15.00
Retort tar, bbl.	500 lb.	15.00 —	15.50
Rosin oil, first run	gal.	.72 —	–
Rosin oil, second run	gal.	.75 —	–
Rosin oil, third run	gal.	.92 —	–

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.40
70-72 deg., steel bbls. (85 lb.)	gal.	.38
68-70 deg., steel bbls. (85 lb.)	gal.	.37
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.29

Crude Rubber

Para—Upriver fine	lb.	$0.26 —	$0.26½
Upriver coarse	lb.	.17 —	.18
Upriver caucho ball	lb.	.17½ —	.18½
Plantation—First latex crepe	lb.	.25 —	–
Ribbed smoked sheets	lb.	.24½ —	–
Brown crepe, thin, clean	lb.	.22½ —	–
Amber crepe No. 1	lb.	.22 —	–

Oils

VEGETABLE

The following prices are f.o.b., New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.16½ —	$0.18
Castor oil, AA, in bbls.	lb.	.15 —	.16
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.17 —	.17½
Cocoanut oil, Ceylon grade, in bbls.	lb.	.15½ —	.16
Cocoanut oil, Cochin grade, in bbls (nominal)	lb.	.17½ —	.17½
Corn oil, crude, in bbls.	lb.	.12 —	.13
Cottonseed oil, crude (f.o.b. mill)	lb.	.10¼ —	.11
Cottonseed oil, summer yellow	lb.	.13 —	.14
Coteonseed oil, winter yellow	lb.	–	–
Linseed oil, raw, car lots (domestic)	gal.	1.07 —	–
Linseed oil, raw, tank cars (domestic)	gal.	1.00 —	
Linseed oil, boiled, car lots (domestic)	gal.	1.09 —	

Olive oil, commercial	gal.	3.00 —	3.50
Palm, Lagos	lb.	.10½ —	.10¾
Palm, bright red	lb.	—	—
Palm, Niger	lb.	.09½ —	.10
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10¾ —	.12½
Peanut oil, refined, in bbls	lb.	.17 —	.18
Rapeseed oil, refined in bbls	gal.	1.30 —	1.45
Rapeseed oil, blown, in bbls	gal.	1.60 —	1.70
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.14 —	.14½
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.10 —	.11

FISH

Light pressed Menhaden	gal.	$0.80 —	$0.90
Yellow bleached Menhaden	gal.	.83 —	.84
White bleached Menhaden	gal.	.86 —	.87
Blown Menhaden	gal.	.90 —	1.00

Miscellaneous Materials

All f. o. b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00 —	$30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00 —	26.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	10.00 —	12.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50 —	28.00
Barytes, crude, first grade, Missouri	net ton	10.00 —	—
Blanc fixe, dry	lb.	.05½ —	.06
Blanc fixe, pulp	net ton	60.00 —	80.00
Casein	lb.	.15 —	.18
Chalk, domestic, extra light	lb.	.05 —	.06
Chalk, domestic, light	lb.	.04½ —	.05½
Chalk, domestic, heavy	lb.	.04 —	.05
Chalk, English, extra light	lb.	.05 —	.07
Chalk, English, light	lb.	.05 —	.06
Chalk, English, dense	lb.	.04½ —	.05
China clay, (Kaolin) crude, f.o.b. mines, Georgia	net ton	9.00 —	12.00
China clay (Kaolin) washed, f.o.b. Georgia	net ton	12.00 —	15.00
China clay (Kaolin) powdered, f.o.b. Georgia	net ton	18.00 —	22.00
China clay (Kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (Kaolin) ground, f.o.b. Virginia points	net ton	15.00 —	40.00
China clay (Kaolin), imported, lump	net ton	25.00 —	35.00
China clay (Kaolin), imported, powdered	net ton	30.00 —	60.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	7.50 —	8.00
Feldspar, crude, f.o.b. Maine	net ton	7.50 —	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00 —	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	30.00 —	35.00
Fuller's earth, granular, f.o.b. Fla.	net ton	25.00 —	—
Fuller's earth, powdered, f.o.b. Fla.	net ton	18.00 —	—
Fuller's earth, imported, powdered	net ton	35.00 —	40.00
Graphite, crucible, 90% carbon, Ashland, Ala.	lb.	—	.09
Graphite, crucible, 85% carbon, Ashland, Ala.	lb.	.07 —	.09
Graphite, higher lubricating grades	lb.	.11 —	.40
Pumice stone, imported, lump	lb.	.04 —	.50
Pumice stone, domestic, lump	lb.	.06 —	—
Pumice stone, ground	lb.	.04 —	.07
Quartz (acid tower) fist to head, f.o.b. Baltimore	net ton	—	10.00
Quartz (acid tower) 1¼@2 in., f.o.b. Baltimore	net ton	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	—	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00 —	7.50
Shellac, orange fine	lb.	1.15 —	1.30
Shellac, orange superfine	lb.	1.10 —	1.20
Shellac, A. C. garnet	lb.	.90 —	.95
Shellac, T. N.	lb.	.85 —	.95
Soapstone	ton	15.00 —	25.00
Talc, paper-making grades, f.o.b. Vermont	ton	12.00 —	22.00
Talc, roofing grades, f.o.b. Vermont	ton	9.50 —	15.00
Talc, rubber grades, f.o.b. Vermont	ton	12.00 —	18.00
Talc, powdered, Southern, f.o.b. cars	ton	12.00 —	15.00
Talc, imported	ton	60.00 —	70.00
Talc, California Talcum Powder grade	ton	20.00 —	35.00

Refractories

Bauxite brick, 56% Al., f.o.b. Pittsburgh	1,000	160
Chrome brick, f.o.b. Eastern shipping points	net ton	100–110
Chrome cement, 40-45% Cr_2O_3	net ton	55–60
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	60–65
Fire clay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	55–60
Fire clay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	45–50
Magnesite brick, 9-in. straight	net ton	110
Magnesite brick, 9-in. arches, wedges and keys	net ton	121
Magnesite brick, soaps and splits	net ton	134
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	65–70
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	56–61
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	55–60

Ferro-Alloys

All f.o.b. Works

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$250.000
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon, carlots	lb.	.18 —	.19
Ferro-chrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.20 —	.21
Ferro-manganese, 76-80% Mn, domestic	gross ton	170.00 —	175.00
Ferro-manganese, 76-80% Mn, English	gross ton	170.00 —	175.00
Spiegeleisen, 18-22% Mn	gross ton	82.50 —	85.00
Ferro-molybdenum, 50-60% Mo, per lb. of Mo.	lb.	2.00 —	2.50
Ferro-silicon, 10-15%	gross ton	60.00 —	65.00
Ferro-silicon, 50%	gross ton	80.00 —	90.00
Ferro-silicon, 75%	gross ton	150.00 —	160.00
Ferro-tungsten, 70-80%, per lb. of contained W.	lb.	.80 —	.90
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	7.00 —	—
Ferro-vanadium, 30-40% per lb. of contained V.	lb.	6.50 —	8.50

Ores and Semi-finished Products

All f.o.b. Mines, Unless Otherwise Stated

Bauxite, 52% Al. content, less than 2% Fe_2O_3, up to 20% silica, not more than 14% moisture	gross ton	$10.00 —	$11.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.70	.75
Chrome ore, 50%, max., Cr_2O_3 f.o.b. Atlantic Seaboard	unit	.75 —	.85
*Coke, foundry, f.o.b. ovens	net ton	—	18.00
*Coke, furnace, f.o.b. ovens	net ton	16.50 —	17.00
*Coke, petroleum, refinery, Atlantic Seaboard	net ton	24.00	
Fluor spar, lump, f.o.b. Tonuco, New Mexico	net ton	17.50 —	—
Fluor spar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	80.00 —	100.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	85.02
Manganese Ore, 50% Mn, c.i.f. Atlantic seaport	unit	.60 —	.70
Manganese ore, chemical (MnO_2)	gross ton	70.00 —	80.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.65 —	.70
Monazite, per unit of ThO_2	unit	42.00 —	—
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	12 —	—
Pyrites, Spanish, furnace size, c.i.f., Atlantic seaport	unit	.16½ —	—
Pyrites, Spanish, run of mines, ci.f., Atlantic seaport	unit	12 —	.14
Pyrites, domestic, fines	unit	.12 —	.14
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	—
Tungsten, Scheelite, 60% WO_3 and over, per unit of WO_3	unit	6.00 —	—
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	4.50 —	5.00
Uranium Ore (Carnotite) per lb. of U_3O_8	lb.	2.75 —	3.00
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.75 —	3.00
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium Ore, per lb. of V_2O_5 contained	lb.	1.25 —	1.50
Zircon, washed, iron free	lb.	.05 —	—

*Nominal

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	16.50
Aluminum, 98 to 99 per cent	33.00
Antimony, wholesale lots, Chinese and Japanese	6.50@7.00
Nickel, ordinary (Ingot)	43.00
Nickel, electrolytic	45.00
Tin, 5-ton lots	39.50
Lead, New York, spot	8.00
Lead, E. St. Louis, spot	8.00
Zinc, spot, New York	8.50
Zinc, spot, E. St. Louis	7.50@7.70

OTHER METALS

Silver (Commercial)	oz.	$0.91½
Cadmium	lb.	1.40@1.50
Bismuth (500 lb. lots)	lb.	2.55
Cobalt	lb.	6.00
Magnesium (f.o.b. Niagara Falls)	lb.	1.75
Platinum	oz.	95.00@105.00
Iridium	oz.	400.00@450.00
Palladium	oz.	95.00@100.00
Mercury	75 lb.	70.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	31.50
Copper bottoms	36.00
Copper rods	30.00@35.00
High brass wire and sheets	29.25
High brass rods	25.00
Low brass wire and sheets	31.25
Low brass rods	27.00
Brazed brass tubing	38.25
Brazed bronze tubing	43.00
Seamless copper tubing	31.00@32.00
Seamless high brass tubing	30.00@31.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound.

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy and crucible	13.50	17.00	12.00	13.50
Copper, heavy and wire	13.00	16.00	11.75	12.50
Copper, light and bottoms	11.00	14.00	10.00	11.00
Lead, heavy	5.50	4.75	5.50	6.00
Lead, tea	4.50	3.75	3.75	5.00
Brass, heavy	7.00	10.50	8.00	12.50
Brass, light	5.50	7.50	5.00	6.50
No. 1 yellow brass turnings	7.00	10.00	6.00	6.75
Zinc	4.50	5.00	3.75	5.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.30	$4.47	$3.47	$3.44	$3.37	$4.08	$3.47
Soft steel bars	4.75	4.62	3.37	3.84	3.27	3.98	3.37
Soft steel bar shapes	4.75	4.62	3.37	3.84	3.27	3.98	3.37
Soft steel bands	6.43	6.32	4.07	6.25			
Plates, ¼ to 1 in. thick	4.50	4.67	3.67	3.64	3.57	4.28	3.67

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The Conners Steel Co., Brown Marx Bldg., will build a 1-story, 77x400-ft. steel building for a steel mill, on 51st Pl. and Powell Ave. Estimated cost, $50,000. Work will be done by day labor.

Colorado

LAFAYETTE—The Grand Valley Sugar Corp. plans to build a 600-ton mill. Equipment will be installed in same. Estimated cost, $100,000.

STERLING—The Great Western Sugar Co., Sugar Bldg., Denver, will build a sugar factory to have a 1,200-ton capacity near here. Estimated cost, $2,000,000. Work will be done by day labor.

Connecticut

NEW HAVEN — The Connecticut Adamant Plaster Co., River St., has awarded the contract for the construction of a 2-story, 120x160-ft. plaster factory to the Sperry Eng. Co., 82 Church St. Estimated cost, $150,000. Noted Oct. 13.

Florida

LEESBURG—The Grass Fibre Pulp & Paper Corp. is building 3 paper pulp mills. Estimated cost, $75,000. C. T. Logan, 1228 Crittenden, N. W., Washington, D. C., engr.

Illinois

EAST MOLINE — The Moline Pressed Steel Co. plans to build a 50x150-ft. enameling room and install an oven at its plant here.

Indiana

ANDERSON—The Lynch Glass Co. has awarded the contract for the construction of a 1-story, 50x-120-ft. addition to its factory to the H. K. Ferguson Co., 6521 Euclid Ave., Cleveland, O. Estimated cost, $60,000.

Iowa

GILMORE CITY—The city has awarded the contract for the construction of a sewage disposal plant to Phelps & Sons, Knoxville. Estimated cost, $27,300.

Kansas

GALENA—The Eagle Picher Lead Co., Smelter Hill, Joplin, Mo., is having plans prepared for the construction of a 1-story smelter building on Milter St. here. Estimated cost, $75,000. J. E. Webb, mgr.

Maine

FAIRFIELD — The Keyes Fibre Co., Waterville, has awarded the contract for the construction of a 1- and 2-story pulp mill to the Aberthaw Constr. Co., 27 School St., Boston, Mass. Estimated cost, $125,000.

Maryland

BALTIMORE—A. Weiskittel & Son Co., 12th and Lombard Sts., plans to build a 1-story foundry, etc. Estimated cost, $6,000.

Massachusetts

WESTFIELD—The Vitrified Wheel Co., Emery St., has awarded the contract for the construction of a 2-story, 45x100-ft. addition to its plant to P. J. Mahoney, 46 Orange St. Estimated cost, $40,000. Noted Oct. 20.

Minnesota

AITKIN—The Bd. Educ. is having plans prepared for the construction of a 3-story high school. A chemical laboratory will be installed in same. Estimated cost, $400,000. A. Casey, clk. K. T. Snyder, 738 Plymouth Bldg., Minneapolis, and H. Swanson, Crosby, engrs.

MINNEAPOLIS—The Bd. Educ. will receive bids about Nov. 25 for the construction of a 4-story, 220x300-ft. senior high school on 20th Ave., N. E. and Quincy St. A chemical and physical laboratory will be installed in same. Estimated cost, $700,000. E. Enger, 305 City Hall, archt. Noted July 20.

MINNEAPOLIS—The State Bd. of Control, Capitol, St. Paul, has awarded the general contract for the construction of a 3-story addition to the chemistry building on the State University Campus here to J. and W. A. Elliott, 906 Lumber Exch. Estimated cost, $239,416. Noted July 28.

NORTHFIELD—Carleton College plans to build 11 college buildings to cost $3,150,000. Plans include the construction of a chemistry building to cost $300,000. D. J. Cowling, pres.

ST. PAUL—The city has received bids for 30,000 lb. liquid chlorine for treating city water in 100-lb. cylinders, from Noyes & Bros. & Butler, 6th and Sibley Sts., $0.09 per lb., Electro Bleaching Gas Co., 18 East 41st St., New York City, $0.0925 per lb., Hooker Electro Chemical Co., 25 Vine St., New York City, $0.1089. Noted Oct. 5.

New Jersey

FLORENCE—The Florence Foundry Co. will soon award the contract for the construction of a 2-story, 50x100-ft. factory. Estimated cost, $50,000. J. W. Levin, Liberty Bldg., Philadelphia, Pa., archt.

North Carolina

CANTON—The Champion Fibre Co. will build a 60x350-ft. pulp and paper mill. Work will be done by day labor.

North Dakota

HANKINSON—The city has awarded the contract for the construction of a sewer system to John O'Connor Co., Fargo. A septic tank and sludge bed will be installed in same. Estimated cost, $82,000.

Ohio

CHAGRIN FALLS—The Adams Bag Co. has awarded the contract for the construction of a 1-story paper mill addition to the Myers-Kuhn Constr. Co., Metropolitan Bldg., Cleveland, O. Estimated cost, $50,000. Noted Sept. 15

CLEVELAND — The Atlas Fdry. Co., Shaw Ave., is having plans prepared for the construction of a 1-story, 50x100-ft. addition to its foundry on West 69th St. Estimated cost, $40,000. J. E. Moore, 1900 Euclid Ave., archt. and engr.

Pennsylvania

FERNWOOD—The Eastern Fdry. & Machine Co., Ambler, has awarded the contract for the construction of a 1-story, 85x115-ft. manufacturing building here to C. R. Davis & Son, 15th and Ellsworth Sts., Philadelphia. Estimated cost, $20,000.

PHILADELPHIA—The Sleight Metallic Ink Co., 5907 Market St., has awarded the contract for altering the present 2-story building at 538 North 3d St., to the F. Mark Constr. Co., 2820 North 21st St. Estimated cost, $10,000.

STATE COLLEGE — The Pennsylvania State College has awarded the contract for the construction of a 2-story, 60x160-ft. steel laboratory to the Austin Co., Bulletin Bldg., Philadelphia. Estimated cost, $75,000.

South Carolina

UNION—The City Gas Co. plans to build a gas plant. Estimated cost, $150,000. T. McNally, pres.

Tennessee

CHATTANOOGA—The Mutual Enamel Wks. Co. has awarded the contract for the construction of a foundry and plant to D. P. Robinson, 125 East 46th St., New York City. Estimated cost, $800,000.

Wisconsin

DEPERE—St. Norberts College, Boyle Hall, is having plans prepared for the construction of a 3-story, 80x260-ft. science hall. A chemical laboratory will be installed in same. Estimated cost, $400,000. W. E. Reynolds, 113 South Roosevelt St., Green Bay, archt.

KENOSHA — The Wisconsin Oxygen Hydrogen Co., Marion Ave. along the tracks of the Chicago & Northwestern R.R., is building a 45x109-ft. building. Estimated cost, $60,000. White, White, White & Co., 411-415 Pub. Servc. Bldg., archts.

MILWAUKEE — H. A. Poppert, 505 Cedar St., is in the market for brass foundry equipment, including blowers.

MILWAUKEE — The Shope Brick Co., 831 M. & M. Bldg., has awarded the contract for the construction of a 1-story, 90x145-ft. brick plant on State St., to the Amer. Contg. Co., 198 Milwaukee St. Estimated cost, $25,000.

TOMAHAWK—The Tomahawk Pulp & Paper Co. is having plans prepared for the construction of several buildings to include a 50x231-ft. machine room, etc. V. E. Labbe, secy.

Wyoming

CASPER—The city plans an election on Nov. 2 to vote on $250,000 bonds to construct sewers. Flushtanks will be installed in same. F. S. Knittle, City Engr.

Ontario

ALMONTE — The city engaged A. F. Macallum, engr., City Hall, Ottawa, to prepare plans and submit estimates for a waterworks system to include filters, reservoir, distribution system, etc. Estimated cost, $263,695.

COOKSVILLE—The Shale Brick Co. of Canada, Crown Office Bldg., Toronto, plans to make repairs to present brick plant. Estimated cost, $30,000.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its 1920 meeting Dec. 27, 1920, to Jan. 1, 1921, at Chicago, Ill.

AMERICAN ASSOCIATION OF ENGINEERS will hold a meeting on employment and education in the Congress Hotel, Chicago, on Nov. 12.

AMERICAN CERAMIC SOCIETY will hold its annual meeting the week of Feb. 21, 1921, at Columbus, Ohio, with headquarters at the Deschler Hotel.

AMERICAN ENGINEERING COUNCIL of the Federated American Engineering Societies will hold a meeting Nov. 18 and 19, 1920, in Washington, D. C. Headquarters will be at the New Willard Hotel.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at New Orleans, Dec. 6 to 9. Headquarters will be at the Hotel St. Charles.

AMERICAN MINING CONGRESS will hold its next convention in Denver Nov. 15 to 19.

AMERICAN PHYSICAL SOCIETY will hold a meeting Nov. 27 at the Case School of Applied Science, Cleveland, and the annual meeting, beginning Dec. 28, at Chicago, the latter being the occasion of the special quadrennial meeting of the American Association for the Advancement of Science and the Affiliated Societies.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS' 1920 annual meeting will be held in the Engineering Societies' Building from Dec. 7 to 10 inclusive.

PHILADELPHIA SECTION, AMERICAN CHEMICAL SOCIETY, will hold its regular meeting Nov. 18 at the Engineers' Club, Philadelphia. Ellwood Hendrick will speak on "Relativity and Life."

SOCIETY OF INDUSTRIAL ENGINEERS will hold its fall national convention at Carnegie Music Hall, Pittsburgh, Pa., Nov. 10, 11 and 12.

The following chemical societies will meet at Rumford Hall, Chemists' Club, New York City, as follows: Nov. 5, Society of Chemical Industry; Nov. 19, American Chemical Society; Dec. 10, American Chemical Society, joint meeting with Society of Chemical Industry, American Electrochemical Society and Société de Chimie Industrielle; Jan. 7, American Chemical Society; Jan. 14, Society of Chemical Industry, Perkin Medal award; Feb. 11, American Electrochemical Society, joint meeting with Society of Chemical Industry, American Chemical Society and Société de Chimie Industrielle; March 11, American Chemical Society, Nichols Medal award; March 25, Society of Chemical Industry; April 22, Society of Chemical Industry, joint meeting with American Electrochemical Society, Société de Chimie Industrielle and American Chemical Society; May 6, American Chemical Society; May 13, Société de Chimie Industrielle, joint meeting with American Chemical Society, Society of Chemical Industry, and American Electrochemical Society; May 20, Society of Chemical Industry; June 10, American Chemical Society.